The FOUNDRY

Volume 52
Number 10

Published
Semimonthly

CLEVELAND, OHIO, MAY 15, 1924

Molding Special Pipe Shapes

Interesting Equipment Has Been Developed for the Production of Large Valves and Special Shapes Which Usually Are Ordered in Single Units or in Limited Numbers

BY PAT DWYER

ORIGINALLY named in honor of a great English statesman, the present city of Pittsburgh perpetuates his name in a manner beyond even the most sanguine expectations of the daring band of British and Colonial troops who on Nov. 25, 1758, nailed the English ensign above the block house that marked the western boundary of British supremacy in her American colonies.

Bancroft the historian, states: "It is the most enduring monument to William Pitt. America raised to his name statues that have been wrongfully broken and granite piles of which not one stone remains upon another; but so long as the Monongahela and the Allegheny shall flow to form the Ohio, so long as the English tongue shall be the language of freedom in the

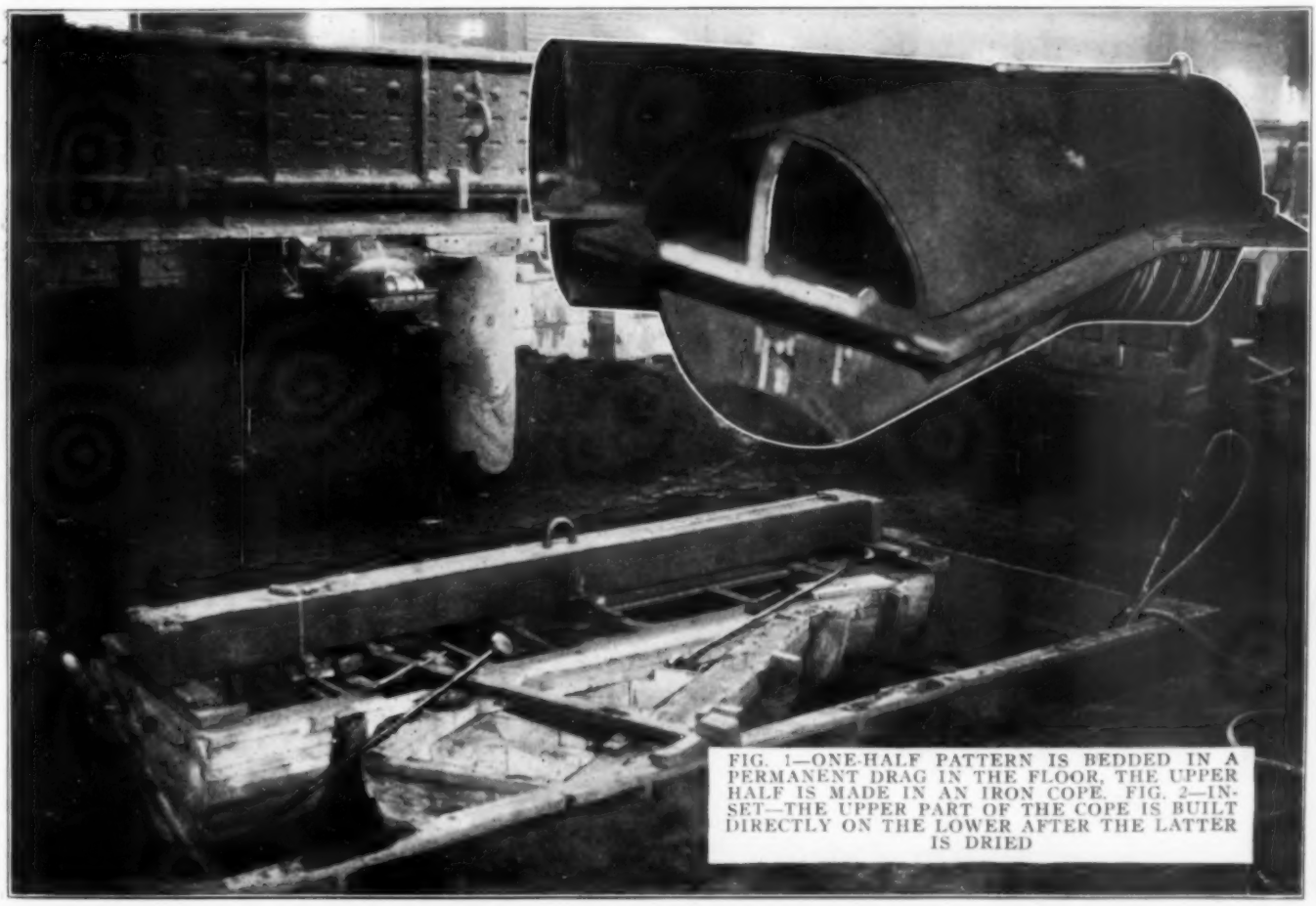


FIG. 1—ONE-HALF PATTERN IS BEDDED IN A PERMANENT DRAG IN THE FLOOR, THE UPPER HALF IS MADE IN AN IRON COPE. FIG. 2—INSET—THE UPPER PART OF THE COPE IS BUILT DIRECTLY ON THE LOWER AFTER THE LATTER IS DRIED

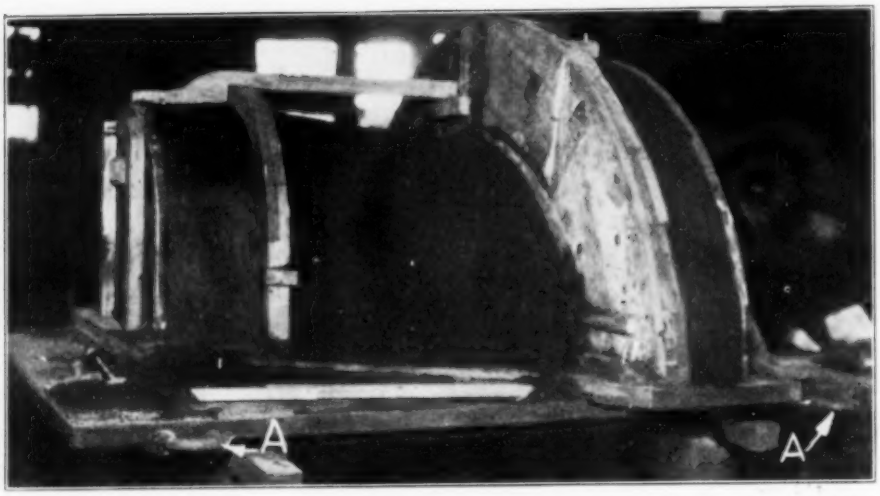


FIG. 3—THE SAND IS GIVEN ITS PROPER FORM IN THE FRAME BY A NUMBER OF STRIKES OPERATING ON SUITABLE GUIDES

boundless valleys traversed by their waters, his name shall stand inscribed on the gateway of the West."

The site was one of the last occupied by the French in their long drawn out fight with the British to retain the territory first explored by La Salle and placed under the fleur-de-lis. Considered from one standpoint the smoldering ruins and ashes of Fort Duquesne evacuated by the French symbolized the lost hopes of a nation to establish extensive colonies beyond the sea. From another standpoint one may be justified in claiming that these same smoldering ruins fanned by the breath of industry, have been responsible for the establishment and growth of a community recognized as the hearth of a nation at which the spirit of Tubal Cain magnified to the nth degree, still presides. The extent to which disciples of the cunning old artificer in brass and iron have followed in his footsteps and improved on his methods is exemplified by the fact that the Pittsburgh district produces approximately 65 per cent of all the coke, 25 per cent of the pig iron, 40 per cent of the steel made in the United States. It rolls more rails than any other place and is the center of the glass industry.

In a manufacturing center of this character, it is natural to find that the foundry industry is represented in a creditable manner by 70 foundries engaged in the production of castings in practically all kinds of ferrous and nonferrous metals. Some foundries cater only to local trade while others fill contracts for castings from widely separated parts of the United States and foreign countries. The Pittsburgh Valve, Foundry & Construction Co., in the latter class, specializes as the name implies, in valves, valve fittings and related castings and operates three individual foundries for the purpose, one for iron, one for steel and one for nonferrous castings.

The plant comprising foundries, machine shop, pattern shop, steel pipe bending and fitting shop, power house, various other auxiliary departments, general office which houses executive, operating and engineering forces, is located on the main line of the Allegheny Valley railroad at Twenty-sixth street. Spurs from the main line enter the yard and the various shops and facilitate the movement inward of raw material and outward of finished products.

The iron foundry building of brick and steel construction was erected nearly 50 years ago, but was so far ahead of the usual foundry built at that period that it compares favorably with many modern casting plants engaged in the production of large castings. It was one of the first foundries in the country to install electric traveling cranes and still has in active service one crane that was erected 31 years ago and a second that dates back 29 years.

The lighting facilities are excellent as may be noted from the various illustrations. Rows of windows in the sides and ends are supplemented by windows in the vertical sides and sloping sides of the monitor roof that spans the main bay from one end to the other. Several skylights have been provided in the

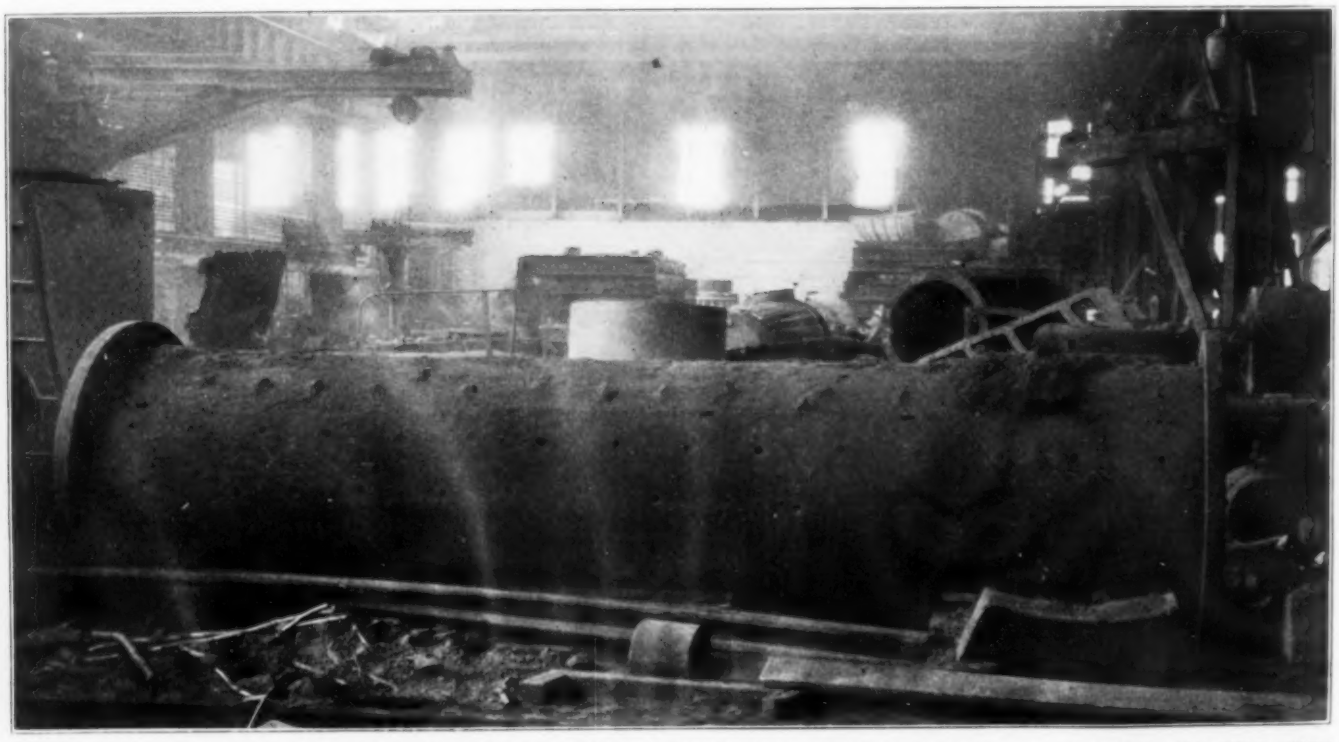


FIG. 4—THE BARREL FOR A LARGE PIPE CORE IS MADE UP OF THREE PARTS, THE STRAIGHT SECTION AND TWO ENDS —THE ENDS ARE BOLTED TO INTERNAL FLANGES ON THE STRAIGHT SECTION

roof of each of the side bays. Over one side they merely serve as conductors of light. Over the other side in the vicinity of the core ovens they also serve as ventilators for the removal of gas and smoke.

The 200 x 300-foot foundry is separated into three main divisions or bays by two rows of structural steel columns that support the crane runways in the center bay. Small castings and others weighing up to approximately 200 pounds are made in the west bay on a battery of power operated squeeze and jolt machines supplied by the Osborn Mfg. Co., Cleveland. A space at one end of the bay is utilized for the storage of patterns and flasks. A space at the other end serves as a repair shop for the foundry carpenter.

The center bay is devoted almost exclusively to molding large castings. A space at the north end is occupied by a series of concrete sand bins in which new molding sand and new core sand are stored until required. A corresponding space at the opposite end of the bay serves as a general shipping station for large patterns and flasks and also for castings bound for the chipping room in an adjoining building. A standard-gage track extends through the foundry building close to each end and connects with the various standard gage tracks in the yard. A locomotive crane furnishes the motive power for handling the loaded and empty cars within the yard limits. On account of the miscellaneous character of the castings made in this foundry, large iron flasks, arbors and allied equipment almost constantly have to be conveyed into and out of the foundry. Occasionally, the locomotive crane picks up a load direct and carries it into the foundry. Usually the load is placed on or removed from a flat car by one of the electric cranes in the foundry and locomotive crane in yard.

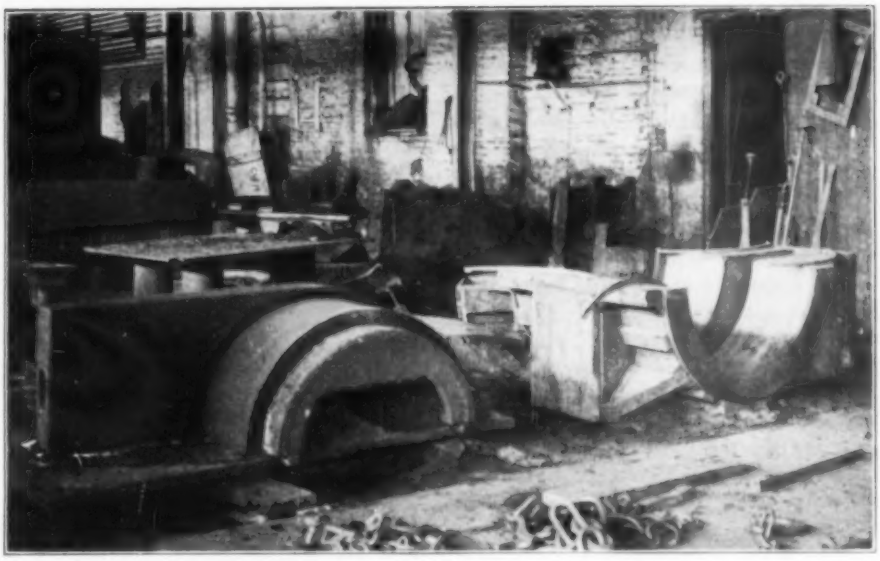


FIG. 6—GATE VALVE BODY CORES ARE MADE ON TWO-PART ARBORS WHICH PREVENT THE SAND FROM SAGGING DURING THE DRYING PROCESS AND ALSO CUT THE REQUIRED AMOUNT OF SAND TO A MINIMUM

Four electric traveling cranes, supplemented by two stationary jib cranes represent the lifting equipment in the center bay. One of 20-ton capacity was supplied by the Morgan Engineering Co., Alliance, O., while one 30-ton and two 5-ton cranes were made by the Shaw Crane Co., Muskegon, Mich. The two large bridge-type cranes span the bay from side to side and operate on a track 30 feet above the floor. Two traveling jib type cranes are attached to suitable tracks on one side of the bay and are erected at a height that permits them to pass under the bridges of the large cranes. The two small stationary jib cranes are located one on either side of the center bay. One serves a roll-over molding machine shown in Figs. 7 and 8 and the other, standing as it does between two columns under the crane runway, is utilized principally for loading and unloading the large core cars. Two, floor-controlled, 5-ton electric traveling cranes serve the coremaking department.

Cars of new sand are spotted on a siding outside the north end of the foundry. The sand is transferred to the concrete bins at the end of the center bay by a traveling bucket suspended from a monorail over the bins. The sand bucket is a self-contained piece of hoisting and conveying equipment in which the operator travels back and forth with the load.

Core sand and facing sand are prepared in a device manufactured by the Standard Sand & Machine Co., Cleveland, and erected close to one end of the sand bins. The various ingredients are fed into a hopper at the floor level, carried up in a bucket elevator and discharged into a revolving screen. From the screen the prepared sand falls into one of a number of steel buckets provided with bails by which they are carried by the crane to any desired point. The amount of coal dust in the green sand facing and the amount of binder in the core sand varies according to requirements, but it is of interest to note that in this foundy, flour is employed almost exclusively as a binder in the core sand mixtures. A natural loam sand from the Ohio river bank forms the base of the mixture for all large cores. Old sand and sharp sand in varying proportions up to 50 per cent are added to individual batches according to the particular requirements of any given set of cores under construction at the time.

Cores for standard shapes are made in half coreboxes and the halves afterward pasted in the usual manner, but the cores for the many special and odd shaped pipe connections are formed in skeleton core frames. Typical examples are shown in Figs. 2 and 3. In the ma-

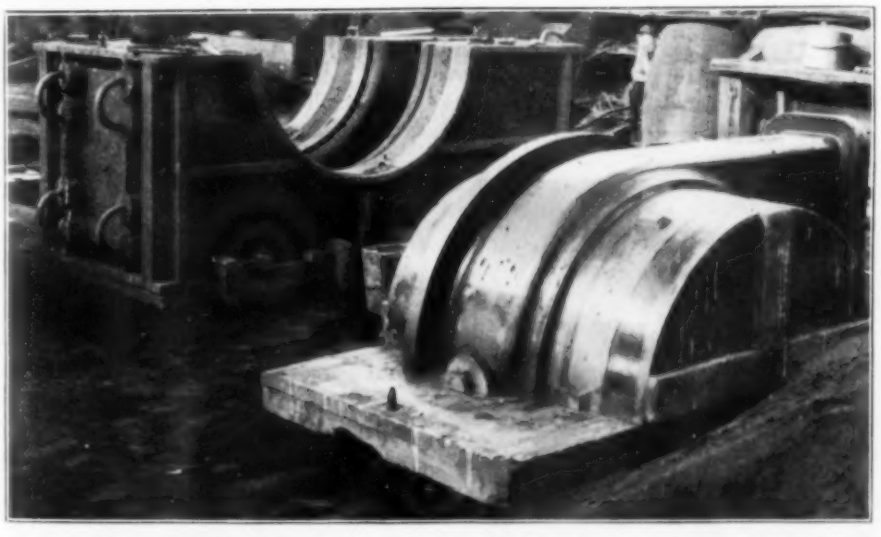


FIG. 5—SPECIAL CLOSE FITTING IRON FLASKS AND PATTERN BOARDS TO WHICH THE PATTERNS ARE ATTACHED, GREATLY FACILITATE THE PRODUCTION OF STANDARD GATE VALVE BODY CASTINGS

jority of cases, only one casting is ordered and the expense incident to corebox and pattern construction must be held to a minimum. In the illustrations it will be noted that only sufficient lumber is employed to form a frame. The greater part of the core outline is formed by strikes or sweeps, guided by suitable shoulders, steps, or other devices on the frame.

The drag half of the core is built directly on a plate as shown in Fig. 3. If one of the core oven cars is available, the plate is mounted on the car, otherwise it is set upon suitable stands on the coreroom floor. The core frame is centered on the plate and rammed full of core sand. Cast iron arbors are employed for reinforcement in some cores while in others scrap pipe and rods are made to serve the same purpose. The center of the core is filled with coke which serves the double purpose of cutting down the drying time in the oven and later provides a ready means for the escape of the gas generated when the core is surrounded by metal in the mold. Hooks are provided on the joint side of the drag core by which it may be handled after it is dried and rolled away from the plate. In this connection it is interesting to note the style of handle on the core plate shown at *A*, *A*, Fig. 3. Core plates usually are plain or simply provided with lugs on the edges and are rather awkward to handle when rolling over a large core. The handles shown at *A*, *A* provide a ready means for attaching the crane chains either to lift the plate horizontally or to roll it over.

On some cores, the two halves are made and dried separately and afterward joined. On others the drag half is made and dried and then rolled joint side up. The upper half of the core then is built in place as shown in Fig. 2. The lower half of the core takes the place of the usual core plate. The core frame is supported on suitable rods extending from the side of the joint, while it is being filled and rammed full of sand. The center is filled with coke as in the drag half, but neither rods nor arbors are required in the majority of cases. Suitable plugs are rammed in place over the hooks on the joint side of the drag half of the core. After the upper half is completed the plugs are removed, thus providing openings for the lifting hooks attached to the crane chains. Occasionally a green sand top is placed on a dry sand half core, but usually, on account of the severe pressure test to which most of the castings are subjected, it is considered best to make the entire core in dry sand.

Cores for plain, straight sections of standard size pipe are made on heavy cast iron pipe arbors similar in general features to the 4-foot diameter arbor shown in Fig. 4. The arbor is made up of three pieces. One straight section provided with dabbers, vent holes and an interanl flange at each end, two end flanges which are bolted to the internal flanges on the straight section. The outside flanges are provided with suitable lifting staples and in that manner are convenient to handle whether the core is to be set either vertically or horizontally in the mold. The outside flanges are machined accurately to size and serve as core prints in the mold and as guides for a long straight edge in forming the core. The upper half of the arbor is covered with rammed sand, scraped to shape and placed in the oven. After it has dried stiff enough to handle, it is removed, rolled over and the second half of the core is built in place. The entire core then is dried. The cores are dried in three large, coke-fired ovens. The tracks from the ovens extend to the center bay of the foundry, where the large cores are lighted by the cranes and placed in the molds.

A half core and corebox for a standard, 36-inch gate valve are shown in Fig. 6. The arbor is made up of two cast iron members, a half barrel and a straight section which enters one side of the barrel and is keyed firmly on the inside. This presents a strong, rigid form of construction and also provides an arbor that easily is taken apart after the casting is poured. Another advantage of this style of core arbor, one that it shares with the arbors for the straight sections, is that the amount of sand is held to a minimum and yet presents

FIG. 8—BOTH HALVES OF THE MOLD ARE MADE AT THE SAME TIME ON A DOUBLE PATTERN OUTFIT

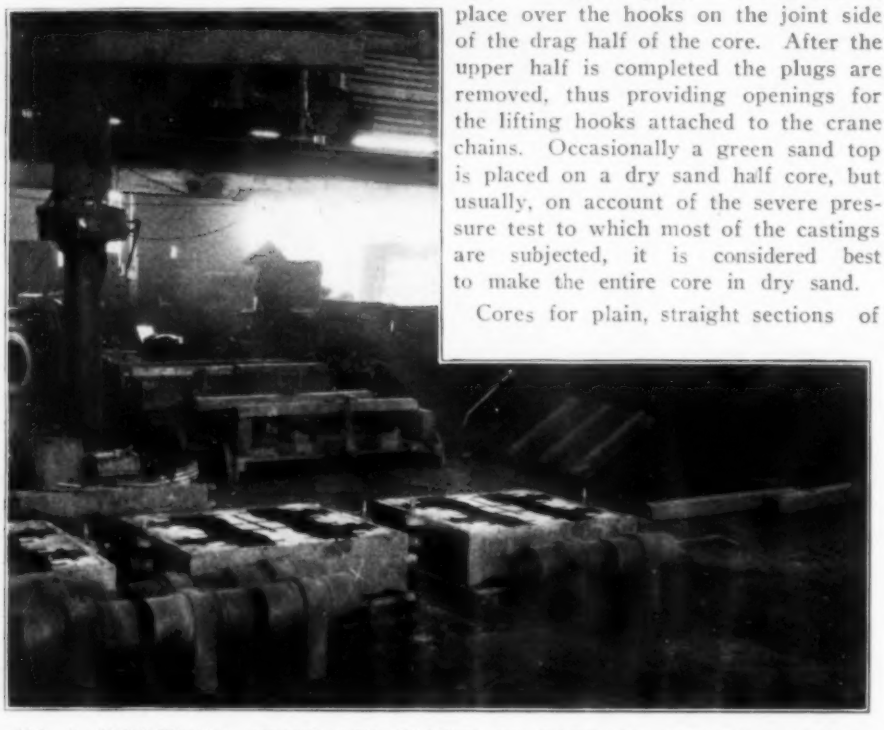


FIG. 7—INDIVIDUAL CORES ARE PLACED IN EACH OF THE FOUR SMALL GATE VALVE BODY MOLDS IN EACH FLASK

sufficient thickness to absorb the natural contraction of the casting. The bearings on the arbor rest directly on the corresponding points on the corebox and later rest on the flanges of the flask. Accuracy and close fit is assured by this method.

The pattern, pattern plate and flask for one of these valves are shown in Fig. 5. Both halves of the mold are rammed on the same board and pattern. The symmetrical pattern is split through the center and the half pattern is attached to the board. The board is provided with center and guide lines to locate the half pattern in its correct position. Suitable guide pins at the ends of the board locate the flask in its proper relative position. The sand forming the mold is rammed with pneumatic rammers. In this connection it is interesting to note that compressed air, water and gas are available for use at any point on the molding floor.

Provides Side Pocket

Many straight sections up to 4 feet diameter and in various lengths are made in the style flask shown in Fig. 9. A half pattern is mounted on a board and both cope and drag are rammed on it. The pattern is the full length of the flask, but castings of any length within that limitation may be produced by shifting the flanges on the pattern. For example in the pipe mold shown in Fig. 9 it will be noted that the actual mold only occupies about two-thirds of the flask. A special pocket is provided at one side to accommodate the gates and runners. The ends of the flask are machined and adjusted to fit snugly over the coreprint on the pattern and arbor. This arrangement insures that the core will center itself automatically and also that it will not shift while the mold is filling with iron. The drag is barred closely over the full length, but the drag is only provided with a few bars near the center to prevent it from spreading under the pressure induced when the mold is filled with molten iron. The bars are held in place by two bolts at each end. All large pipe molds are skin dried with a torch.

Two 10 x 10 x 12-foot pits, lined with cast iron plates, are provided for making large pipe and other cylindrical shapes on end. Several other large pits of varying dimensions, but not so deep, serve to contain the mold of large special shapes molded horizontally. A typical pit of this kind with a pattern partly surrounded by sand is shown in Fig. 1. The pit really is a large cast iron drag sunk flush with the floor line.

In making the mold, the sand is dug out of the pit to a sufficient depth to accommodate the pattern. Under the coreprints the sand is dug away down to the bottom plate and iron bearings are built up to support, first the pattern and later, the core. A weight or a long binder, or a combination of both, as shown in the illustration, is employed to prevent the pattern from shifting while the sand is being rammed under and around it.

Consider Expense

Patterns for these special shapes frequently are only required for the production of one casting and, therefore, the time, expense and material are held to a minimum. No attempt is made to provide a smooth satin finish on the surface and in many cases the pattern does not receive even a single coat of shellac.

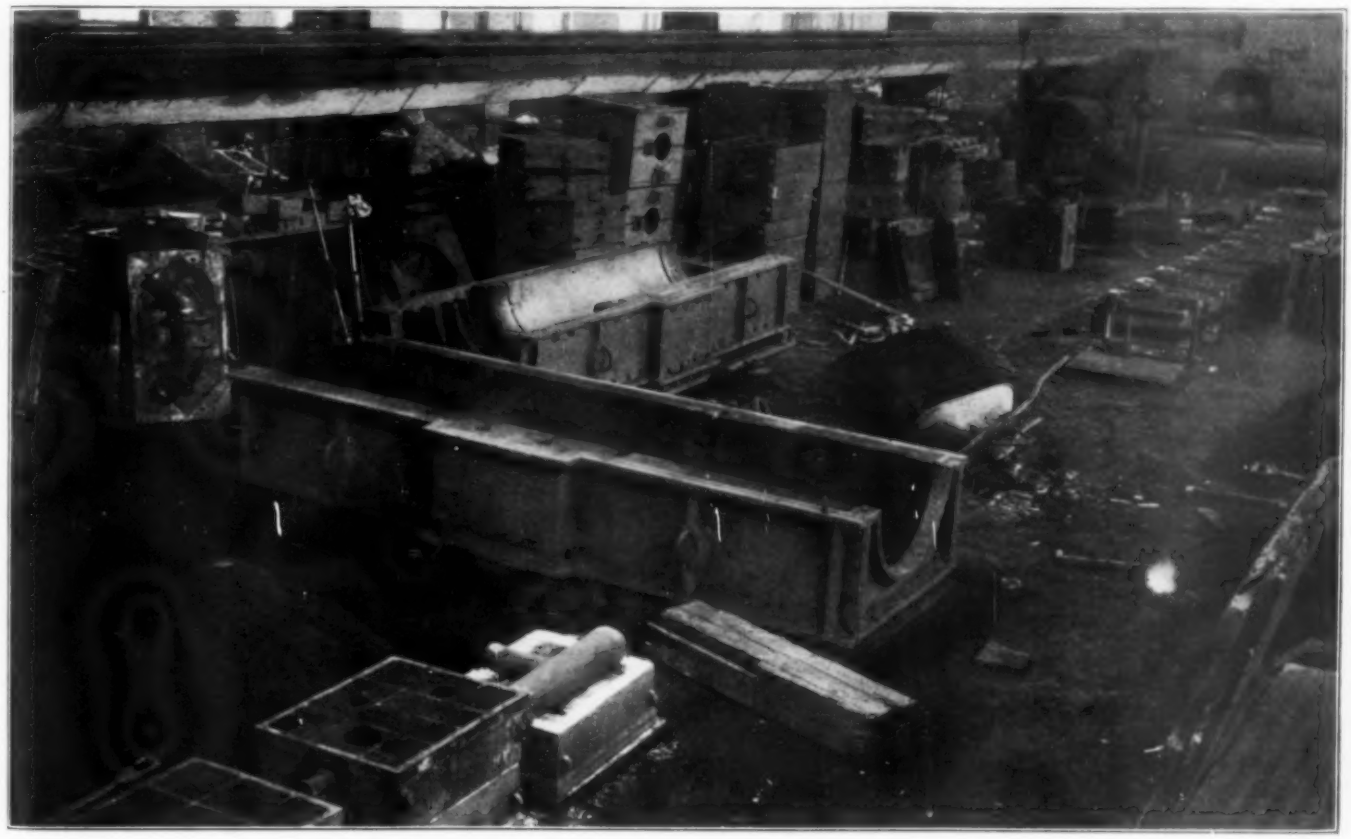


FIG. 9—THE ENDS OF THE FLASK SERVE AS CORE BEARINGS TO LOCATE AND HOLD THE CORE FIRMLY IN PLACE—THE STYLE OF FLASKS IN WHICH SMALLER FITTINGS ARE MADE MAY BE NOTED IN THE BACKGROUND

After it has served its purpose it either is broken or placed in that part of the pattern storage devoted to patterns that are considered obsolete.

A full-size drawing of the pipe is made on the layout board in the pattern shop and the half pattern is built directly on it. Solid half circles are erected at the ends, semicircular frames are erected about 2 feet apart and then a sufficient number of narrow strips are nailed to the ends and frames to form the required shape. Flanges are formed in several sections on the bandsaw and afterward screwed in place on the body of the pattern. The slight inequalities on the surface of the sand after the pattern is withdrawn, easily are slicked down by the molder. He also cuts the fillets on the lines where the flanges join the main

body. The smaller molds are skin dried with a torch, but the larger molds are covered with light plates and dried with gas jets that are allowed to burn until the face of the mold has been dried to a depth varying from ½ inch to 1 inch.

The iron cope flask shown in the upper left Fig. 2 is designed to serve for any shape pipe that will fit inside its walls. In the illustration it is shown with a 6-inch *upset* or extension frame clamped to the joint side. With a smaller diameter pipe, or one on which the flanges are not so wide or so numerous, the cope is deep enough without the upset. The cope is barred in a manner that facilitates changing to accommodate various size pipes. A set of straight iron bars, 8 inches deep is bolted across the upper part of the cope and remains there permanently. Boards are bolted to these bars horizontally and the remainder of the space between the horizontal bar and the pattern or the joint of the mold, is filled by vertical chuck bars nailed to the horizontal bar. This arrangement provides all the rigidity of an iron barred flask and the flexibility of one provided with wood bars. The cope is not rolled over, but is set upon suitable stands after it has been rammed and lifted off. The pattern is withdrawn and the cope is finished and skin dried in that position.

Many small valves in various sizes are made on a jolt ram rollover machine supplied by the Osborn Mfg. Co., Cleveland, as shown in the illustration Fig. 8. The half symmetrical patterns are mounted on suitable boards and both cope and drag mold are formed simultaneously. The machine is served by a pneumatically-operated, stationary jib crane, but also is in a position where the flasks may be lifted either by one of the wall jib traveling cranes or by one of the bridge type cranes that span the bay from side to side. In the illustration the rope sling is shown attached to the hook of the wall traveling crane.

The method of molding large manhole frames, shown in Fig. 10, presents many interesting features of which the most outstanding is that the seat for the cover is formed by a one-piece chill ring. The drag part of the mold is made on a jolt-ram, rollover machine manufactured by the Herman Pneumatic Machine Co., Pittsburgh and the cope is rammed on a plain jolt machine supplied by the same company. The drag pattern is made up of two parts so that it may be drawn out of the sand from both sides of the drag. The metal part attached to the mold board comprises the large flat rings, the vertical ring and the reinforcing brackets that hold the two parts together. The second part of the pattern is made of wood for convenience in handling and is reinforced with bands.

In making the mold, the drag is filled with sand and jolted. The sand is scraped away until the face of the wood ring is exposed. The ring is rapped and drawn out of the sand and replaced by a one-piece, cast iron, chill ring. This ring is designed to form the shoulder or seat for the manhole cover casting. Additional sand then is shoveled into the drag and butted off with a rammer in the usual manner. A bottom board is clamped in place and the drag is rolled over. The pattern and board are returned to place on the ramming table and the drag is placed on the floor where it forms one of a row of four made each day by a molder and his helper.

Immediately after the casting has set the clamps are knocked off and the combined flask and casting are lifted away from the bottom plate. A sharp pointed bar is employed as a lever in removing the chill from the casting while the load is suspended from the crane. The point of the bar is introduced under the edge of the chill and the edge of the flask serves as a fulcrum. The edge of the chill is tapered slightly and it is stated no particular difficulty is experienced in removing the chill from the casting.

FIG. 10—LARGE MANHOLE FRAMES ARE JOLTED ON A ROLLOVER MACHINE AND THE SEAT FOR THE COVER IS FORMED BY A CAST IRON CHILL RING

The iron for the foundry is melted in two cupolas and distributed by the two traveling cranes, a monorail and a narrow gage track on the floor. The cranes are employed to pour all the large castings. The monorail extends along one side of the center bay from the cupolas to one end of the foundry. It is used for transporting metal for molds made on the bench in that section of the shop. Buggy ladles operate on a narrow gage track laid on the floor between the cupolas in one of the side bays to a point in the opposite side bay where a turntable serves to direct the ladle either to the right or left on a track extending from end to end of the bay.

Compares Foundry Earnings

National Industrial Conference Board Makes Comprehensive Survey of Weekly and Hourly Wage Payments in Foundry and Machine Shop Lines— Employment Trends Also Outlined

A COMPOSITE of wages of all classes of workers in machine shops and foundries in the United States prepared by the National Industrial Conference board, New York, shows average weekly earnings in January were $28.65, compared with $13.61 in July 1914. Average hourly earnings were 58.8 cents, contrasted with 27.8 cents in July 1914. Average weekly earnings for skilled labor were $31.22 compared with $14.85, and for unskilled labor $23.93 against $10.89. Average hourly earnings for skilled labor were 64.2 cents, an advance from 30.7 cents, and for unskilled labor 48.1 cents against 21.4 cents. The composite of all wages in machine shops and foundries at various periods since 1914 is given in the table. A chart showing the trend of wages paid to skilled and unskilled labor and the composite is presented in the accompanying chart.

Returns were received from 614 establishments widely distributed through the manufacturing sections of the country. The largest number of wage earners employed in these plants in any one month was 206,106 in August, 1920. Approximately 18 per cent of the wage earners reported by the 1919 census of manufactures as employed in foundries and machine shops are covered in this report.

The data present a carefully compiled record of wage changes during the period from June, 1920 through January, 1924, gathered from comparable sources. July, 1914 was selected as the base of the study because that month is the last period unaffected by the outbreak of the world war and in general, reflects American manufacturing industries under fairly normal conditions. No attempt was made to study wages during the war period and after July, 1914, the next period covered is June, 1920. From that date through January, 1924, a complete monthly record is available, with the exception of the first half of 1922, which was not covered by an investigation.

About 78 per cent of the plants included in this report furnished complete data from July, 1914 through January, 1924. The remainder could not supply 1914 data, but compiled returns for the period 1920-24. Careful test tabulations showed little divergence in wage data between the 1914-24 group and the 1920-24 group and it was therefore deemed permissible to unite these two groups for the period 1920-24 and to use the 1914 base supplied by the larger group as both the actual and index base for the entire group.

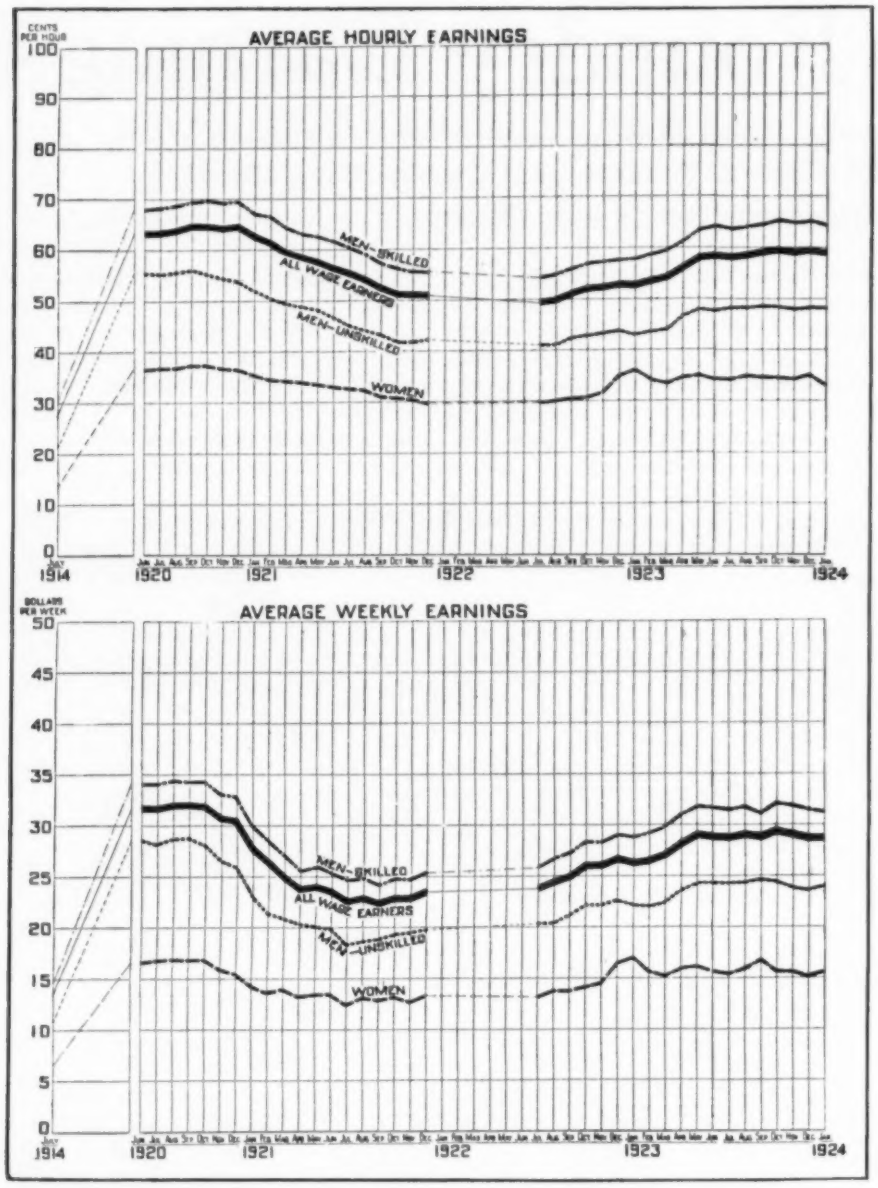
The report deals with wages in the sense of "money earnings" as distinguished from wage rates. Since both the rate and the time worked enter into the computation of earnings, the latter, it is believed, form a more accurate index of industrial activity and labor welfare than would rates alone. The word "earnings," unless otherwise stated, means the total money wages derived from labor services.

Hourly and weekly earnings for each of the three classes in each industry are included in this report. Hourly earnings are obtained by dividing the total weekly payroll in money for each group of wage earners by the total actual man hours worked by that group. Weekly earnings are obtained by dividing the total weekly payroll for each group of wage earners by the number of persons in that group.

It should be borne in mind that, since there are on the payroll a certain number, who on account of illness, voluntary absence, or because of being hired or discharged during the week, fail to work the entire period, the total payroll divided by the number of workers on the payroll will give a figure for average weekly earnings which is slightly below the true average. This, however, is unavoidable, since it would be impossible to obtain data in sufficient detail to correct this tendency, and any attempt to obtain theoretical fulltime earnings by multiplying the average hourly earnings by the hours of plant operation would yield a distorted figure of no significance Since the same method is used in determining

Foundry and Machine Shop Composite Data

Period one week in	ALL WAGE EARNERS: No. wage earners index Nos.	Average week per wage earner	Average hourly earnings	Average weekly earnings	Index Nos. earnings hourly	Index Nos. earnings weekly
1914						
July	....	49.0	$.278	$13.61	100	100
1920						
June	100.0	50.2	.632	31.70	227	233
December	86.2	47.1	.645	30.40	232	223
1921						
January	76.4	44.4	.624	27.67	224	203
March	67.5	41.9	.595	24.96	214	183
May	57.2	41.4	.578	23.94	208	176
August	49.7	42.1	.541	22.77	195	167
October	51.0	44.6	.512	22.85	184	168
December	55.1	46.0	.509	23.40	183	172
1922						
July	72.1	48.0	.495	23.75	178	175
August	73.6	48.8	.499	24.34	179	179
September	75.4	48.8	.511	24.93	184	183
October	79.4	49.9	.520	25.97	187	191
November	82.5	49.7	.523	26.01	188	191
December	85.3	50.4	.528	26.65	190	196
1923						
January	78.2	61.3	.525	32.15	200	215
February	77.9	60.2	.540	32.50	205	217
March	78.9	60.4	.529	31.98	201	214
April	78.2	60.2	.576	34.66	219	232
May	78.2	60.0	.586	35.09	223	235
June	78.3	59.3	.601	35.63	229	238
July	77.9	61.9	.589	36.39	224	243
August	77.9	57.0	.592	33.72	225	225
September	77.5	51.4	.640	32.91	243	220
October	75.4	53.3	.658	35.02	250	234
November	72.2	50.5	.669	33.78	254	226
December	70.5	56.8	.647	36.75	246	246
1924						
January	73.5	53.6	.653	35.02	248	234



WAGE TRENDS IN MACHINE SHOPS AND FOUNDRIES

the average weekly earnings for each month, the possible discrepancies involved in it recur month after month, and a comparison of the averages over a number of months therefore fairly indicates the trend of weekly earnings, which is the object sought.

In order to obtain the most truly representative figures possible for average hourly and weekly earnings of all wage earners in the 23 industries studied, it was deemed advisable to weight them according to census representation. In other words, in arriving at the composite figures it was felt that there should be given to the average earnings of each industry a weight proportionate to the relative importance of that industry as measured by the number of wage earners employed. This result was obtained by multiplying for each month the average hourly and weekly earnings in each industry by the number of wage earners in that industry as reported in the 1919 census of manufacturers, and dividing the sum of these products by the sum of all the wage earners reported by the census for the industries covered. Thus to the level of earnings in each industry is apportioned the value or importance which it should exercise in determining an average for all the wage earners in the industries covered. It is impossible to obtain similarly weighted figures for the classified labor groups, since the classification of wage earners in each industry in the census of manufactures does not correspond with that used in this study.

Dan W. Healy, who has been located at the New York office of the Blaw-Knox Co., has been made district sales manager of the steel building department of that company in New York.

Discuss Melting of Malleable Iron

By George A. Drysdale

Question: We contemplate making medium and light malleable iron castings and will be pleased if you will inform us of the most economical melting furnace to use and the capacity.

Answer: The most economical furnace to use in melting white iron for malleable will depend upon your individual requirements. The air furnace and the cupola furnace are the two types in general use, the air furnace predominating. The air furnace gives economy in melting, more especially where the furnace is used to capacity, and further assures uniformity, and control of the metal. The average capacity of the air furnace ranges from 10 to 20 tons. A few extreme sizes are in use as high as 30 tons and some as low as 5 tons capacity. Cupola furnace metal is not considered as satisfactory as the air furnace product, owing to its lack of uniformity and the higher sulphur and carbon content which tend to weaken the product. For small heats of 5 tons and under and for light work, the cupola furnace will prove the most economical. If your tonnage is likely to fluctuate you should install a furnace of sufficient capacity to handle the maximum amount.

Defective Castings Form Small Percentage

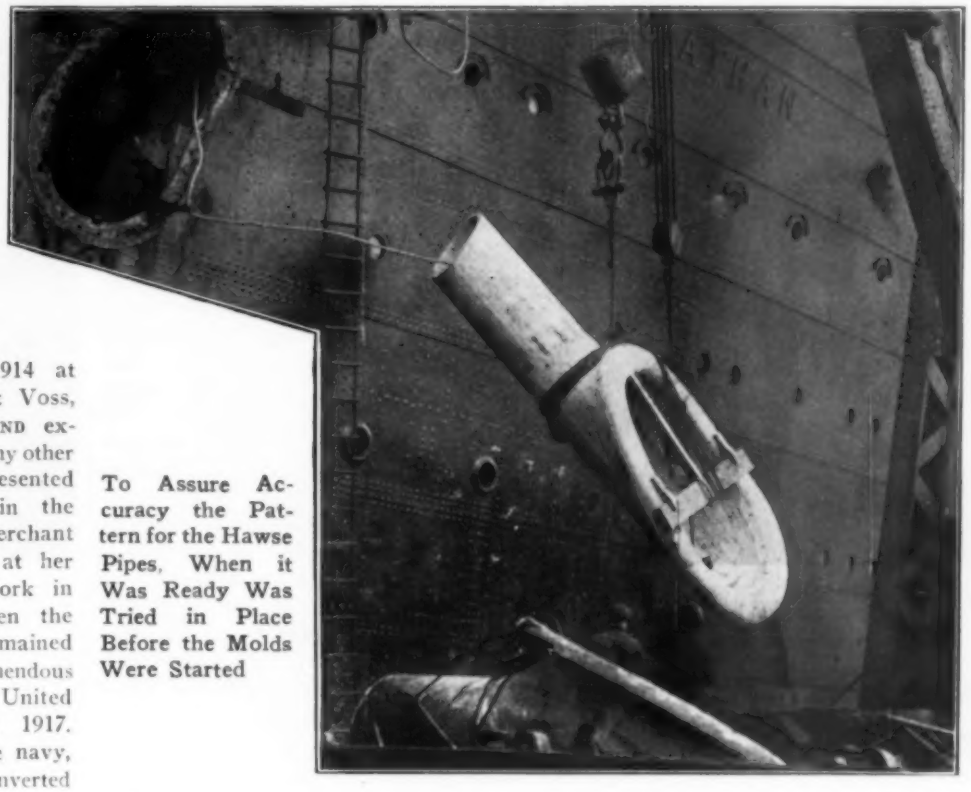
Question: We operate a general jobbing foundry and melt approximately 125 tons per month. We have noted from time to time in various magazines articles touching on the subject of defective castings and are somewhat puzzled to draw conclusions. The percentage of defective castings shown in these various articles ranges from 1 to 10 per cent. Our loss varies from day to day within a range of 3 and 8 per cent for minimum and maximum. Would you consider our casting loss excessive?

Answer: At the present time and under existing conditions your casting loss is typical and may be regarded as normal. In fact if you can hold your losses consistently between the figures indicated you are rather to be congratulated. Even in a highly specialized shop where the operators are trained along certain well defined lines it is difficult to keep the percentage of defective castings within these bounds.

The corporate name of the Bellrose Standard Silica Co., with plants at Ottawa, Ill., has been changed to the Standard Silica Co. The general offices of the company have been moved to 39 South La Salle street, Chicago.

Cast Large Steel Hawse Pipe

Replace Leviathan's Defective Cast Iron Hawse Pipes—Steel Castings Required to Resist Heavy Stress



To Assure Accuracy the Pattern for the Hawse Pipes, When it Was Ready Was Tried in Place Before the Molds Were Started

WHEN completed in 1914 at the yards of Blohm & Voss, Hamburg, the VATERLAND exceeded in size and appointments any other merchant ship afloat and represented the peak of accomplishment in the fast growing and powerful merchant marine of Germany. She was at her berth in the port of New York in August of the same year when the war started in Europe and remained there in safety, but at a tremendous loss to her owners, until the United States declared war in April 1917. Then she was taken over by the navy, renamed LEVIATHAN and converted into a troop ship with a carrying capacity of 13,000 men. First and last she probably has cost more money and has had a more varied experience in a shorter period of time than any passenger boat ever launched.

Early reports given universal circulation indicated that the German crew practically ruined the vital machinery and a considerable part of the fittings before the vessel formally was taken over by the United States authorities. Later reports published after the hysteria of the war years had subsided to a certain extent, tended to minimize some of the features of the earlier reports. However, whether the damage was caused by wilful vandalism or by other agency, the fact remains that an extensive program of repairs was required before the first shipload of troops was carried across the ocean. It seems the irony of fate that the finest ship ever turned out of a German shipyard should be employed for nearly a year in pouring foreign troops into their country.

She was drydocked in Liverpool in the early part of 1918 and after the completion of her last trip Sept. 8, 1919,

FIG. 1—A COMPLETE PATTERN SPLIT LONGITUDINALLY THROUGH THE CENTER WAS MADE FOR THE STARBOARD PIPE AND ANOTHER PATTERN WAS MADE FOR THE PORT HAWSE PIPE—THE PATTERNS WERE MADE IN THE JOINER SHOP CONNECTED WITH THE DRYDOCK

FIG. 2—NEW STEEL STARBOARD HAWSE PIPE AS IT APPEARED WHILE BEING HOISTED INTO PLACE

was laid up at her pier in Hoboken, N. J. Here she stagnated for nearly three years while the government was making up its mind what to do with her. Finally plans and specifications were prepared for a complete reconditioning, including a conversion from coal to oil burning equipment. On Feb. 15, 1922, the contract involving $6,110,000 was awarded the Newport News Shipbuilding & Drydock Co. Other contracts for supplies, equipment and supervision raised the total expense to $8,200,000.

Large Hawse Pipes

The LEVIATHAN arrived at Newport News on April 10, 1922 under her own power and when, on May 16, 1923, she passed down the James river and out beyond the Virginia Capes bound for Boston, she represented the labor of 2300 men working at high pressure for 13 months. At times as many as 2900 men working at fifty different trades were employed. She sailed for the other side on July 4 and remained in constant service until the season closed in December. Early in the present year she underwent her spring overhauling at the plant of the Tietjen & Lang Drydock Co., Hoboken, N. J. a subsidiary of the Todd Shipyards Corp., New York. One of the interesting repair jobs was the replacement of the port and starboard hawse pipes with steel castings made by the Sterling Steel Foundry Co., Braddock, Pa.

The original cast iron hawse pipes made in Germany and installed when

FIG. 4—LOWERING THE CAST IRON PIPE FROM THE PORT SIDE TO MAKE ROOM FOR THE STEEL CASTING

the vessel was built, finally became unserviceable from the heavy duty to which they were subjected. The strain they had to endure readily may be

FIG. 3—THE TWO HALVES OF THE SPLIT PATTERN WERE FASTENED TOGETHER WITH CLEATS TO MAINTAIN ITS SHAPE WHILE IT WAS BEING FITTED IN PLACE IN THE BOW OF THE SHIP AS SHOWN IN THE ILLUSTRATION AT THE HEAD OF THE ARTICLE

imagined when it is stated each of the anchors weighed 33,000 pounds. In this connection it is interesting to note that the steel anchors were made at the Thurlow works of the American Steel Foundries, Chester, Pa. At the time the repairs were effected the cast iron hawse pipes were in bad condition. A piece 15 x 30 inches was broken completely out of the barrel of one and the other presented cracks from 8 to 9 feet long.

Hawse pipes for small vessels sometimes are made from heavy steel pipe cut at a suitable angle at one end to conform to the flare of the bow plates. The end is riveted to a flange. This style of pipe was not applicable to the LEVIATHAN. The repair specification called for a cast steel one-piece pipe with a metal thickness of 2⅝ inches in the barrel and 5 inches in the flange. The finished casting for each hawse pipe weighed nearly 9 tons, was over 18 feet in extreme length, 2 feet 6-inch inside diameter in the barrel which gradually increased and terminated in an elliptical opening 3 feet 10¼ inches on the short axis and 8 feet 4¾ inches on the long axis. The general features and dimensions are shown in Fig. 5 which represents an elevation and horizontal sectional view of the starboard pipe.

No drawings were available and therefore it became necessary for the patternmakers to construct templets and take all necessary measurements from the damaged pipes aboard the vessel. The templet was built as a strong substantial frame accurately fitted to give the exact inside dimensions and shape of the barrel and flange. The frame was taken to the pattern shop where it served as a guide in constructing the pattern. Several alternative methods of making the pattern were considered, but the method illustrated in Figs. 1 and 3 was adopted at the suggestion of the foreman patternmaker from the Sterling Steel Foundry Co., plant. He was influenced in his choice by an intimate knowledge of conditions and equipment in the foundry where the castings were to be made. A complete pattern was made for each pipe.

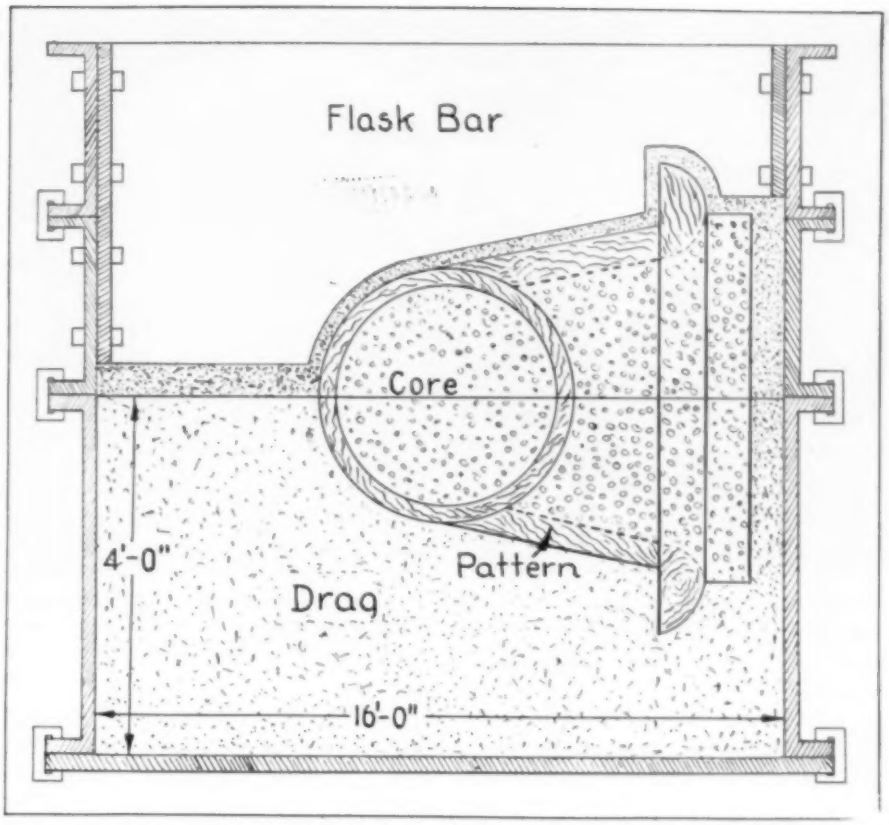


FIG. 6—SECTION TAKEN THROUGH PATTERN AT *B B*, FIG. 5, LOOKING IN THE DIRECTION OF THE ARROWS—THE PATTERN SERVED FOR BOTH PATTERN AND COREBOX

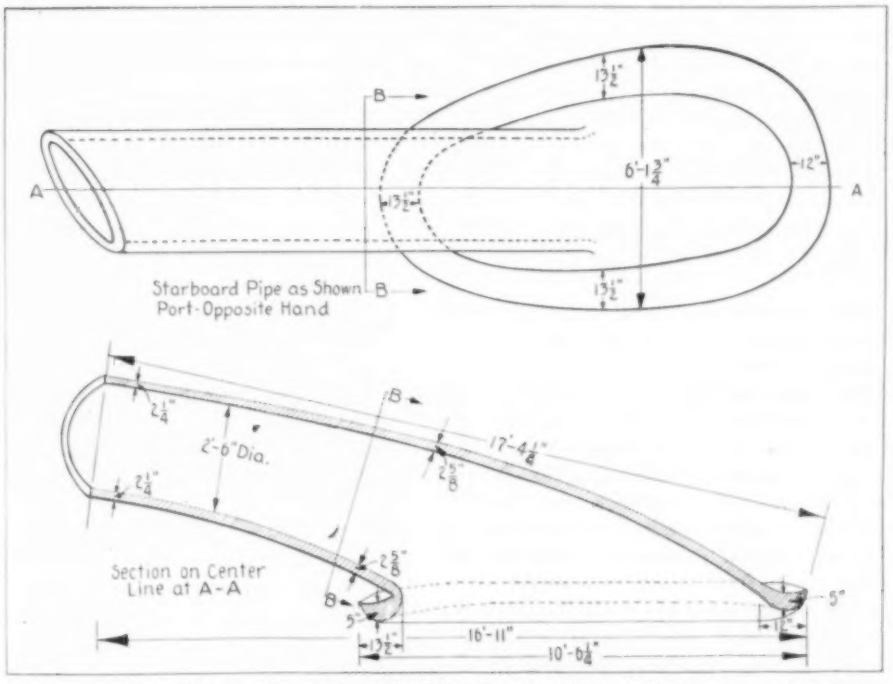


FIG. 5—ELEVATION AND HORIZONTAL SECTIONAL VIEW OF STARBOARD HAWSE PIPE—IT WAS CAST IN THE POSITION SHOWN IN THE UPPER VIEW

Each pattern when completed was an actual replica of the casting plus allowance for contraction. It was split along a center line as shown in Fig. 3. Each pattern consumed about 1500 feet of lumber and weighed 900 pounds. After all dimensions were verified the patterns were shipped to the foundry. A time limit of four weeks was placed on the foundry operation, but the castings were shipped in three weeks from the receipt of the patterns. The castings were fitted in place in the bows of the boat where the rivet holes were marked and drilled in the flange and elsewhere. It is stated that the castings fitted almost perfectly when they were hoisted into place.

It will be noted from the sectional view of the mold shown in Fig. 6 that the drag half of the flask is sunk flush with the foundry floor. It is 16 feet wide, 24 feet long and serves as a pit in which large castings of all kinds are molded. Several pits of this general character are located at various points in the floor of the foundry in

FIG. 7—CASTINGS AS THEY APPEARED ON THE FLOOR OF THE FOUNDRY BEFORE THEY WERE SHIPPED TO THEIR DESTINATION—THEIR RELATIVE SIZE MAY BE GAGED BY COMPARISON WITH THE MAN STANDING AT THE RIGHT

the plant of the Sterling Steel Foundry Co., Braddock, Pa., and two of them were utilized to expedite the production of the hawse pipes. The port pipe was made in one and the starboard pipe was molded in the other at the same time.

The lower half of the pattern was adjusted in the flask so that the joint line of the pattern corresponded with the joint of the flask. Sand was rammed up to the joint line all round and a horizontal parting was made along both sides. The parting at the ends was made to conform to the shape of the opening and was the same shape as would have been made had a core print been attached to the pattern. Solid bearing blocks were built flush with the bottom of the parting line in each print to support the weight of the core. A special steel arbor made of a central member, semicircular side wings spaced about 6 inches apart and suitable plates at the ends, was employed to support the core in each pipe. After the arbor was adjusted in place, it was rammed full of sand up the joint line on the pattern. The upper half of the pattern then was set in place and the remainder of the core was rammed through both open ends. A parting was made at each end, that at the small end following the inside circle and the parting at the ellipticle end following the center of the curve on the flange. This feature is shown in detail at the right Fig. 6. The cope flask was made of two parts clamped together by the flanges and provided with a set of special bars that closely followed the contour of the pattern.

The cope was lifted first and set up on suitable stands to be finished and coated with silica wash. The upper part of the pattern then was removed. The core was lifted out by suitable hooks provided for the purpose and after it had been finished and covered with a thick coating of silica wash it was placed in the core oven and dried. The lower half of the pattern then was lifted out of the drag. After the drag face of the mold was finished the cope was replaced in its proper relative position on the drag and separated from it by a number of 10-inch stools. A gas jet was introduced through each end and the gas was allowed to burn until the face of the mold was thoroughly skin dried. Then the cope was removed temporarily and the core was taken from the oven and lowered into place in the drag. The cope was returned to place and clamped to the drag. Suitable standards were erected on the ends of the core arbor and secured firmly to prevent the core from shifting during the pouring operation.

The casting was gated at the bottom and a large riser was provided at the highest point of the heavy flange. After the castings were cleaned they were annealed in an oven 38 x 12 x 11 feet where they were slowly raised to a temperature of 1470 degrees Fahr. and then allowed to cool slowly. Eight test bars were attached to each casting at various points and the tensile and bend tests taken on each bar satisfied the exacting requirements of inspectors from the Tietjen & Lang Drydock Co., the American bureau of shipping and the United States Steamboat inspection service.

Steel for the castings was melted in an acid-lined, open-hearth furnace and the test bars showed the following physical characteristics: Tensile strength 74,180 pounds per square inch elongation in 2 inches 26 per cent; reduction in area, 45 per cent; cold bend over 1-inch radius, 120 degrees. Chemical analysis of the steel showed carbon 0.28 per cent, manganese 0.57 per cent, phosphorus 0.046 per cent, sulphur 0.037 per cent, silicon 0.29 per cent.

Fuels Used in Melting Malleable Iron

By George A. Drysdale

Question: What kind of fuels are most commonly used for melting malleables in the air and cupola furnace, giving approximate chemical composition of such fuels?

Answer: Coke is the fuel most used in melting iron in a cupola furnace for gray or white iron. In such a furnace where the molten iron comes in contact with the fuel and has a tendency to absorb the sulphur in the fuel it is essential to use a low sulphur coke. The following specifications should govern such a fuel.

COKE

	Per cent
Moisture not over	1.50
Volatile matter not over	2.50
Fixed carbon not under ...	85.00
Ash not over	12.00
Sulphur not over	.75

In general the higher the fixed carbon and lower the sulphur and ash the higher the thermal efficiency. The structure of the fuel also is important. A close-grained, tough structure is necessary to hold up the charges of iron. Such a coke is not so liable to be crushed in handling and charging the cupola.

A long flame, low sulphur and low ash bituminous coal is the fuel commonly used in the air furnace. Although the metal does not come in contact with the fuel, the flame is drawn over the metal which readily absorbs the sulphur from the fuel—it is essential that the sulphur content be as low as possible. A typical analysis of a suitable long flame, low sulphur coal is as follows:

BITUMINOUS COAL

	Per cent
Moisture	1.20
Volatile matter	38.20
Fixed carbon	55.00
Ash	5.00
Sulphur	0.60
	100.00

Notes Sand Test Methods-I

Discuss the Formation of Sand and the Chemical Mineral and Mechanical Properties Most Desired For Molding Purposes—Study Bond Relating to Physical Properties

BY C. W. H. HOLMES

UNTIL recently molding sands were universally bought and used on their reputation for producing good castings, which in view of the lack of fundamental knowledge on the subject, was an excellent proceeding. Subsequently sands were analyzed, and text books informed us that molding sands for steel, gray iron or brass castings should contain so much silica and so much aluminum for each class of work, and further that the sand should contain as little lime, magnesia and alkalies as possible. This again is excellent advice so far as it goes, especially as regards steel castings, but it does not go far enough.

The elementary chemical analysis of a molding sand told the amounts of silica, alumina, lime, etc., which it contained; but the lime does not occur in the sand as *quick* lime; it probably occurs in combination with some silica and some alumina as a lime feldspar. Again the alumina content is no guide as to the bond of the sand; it may occur in grains of feldspar or it may be combined with silica and water as colloidal clay. The latter is a decomposition product of the former, but their functions in a molding sand are essentially different.

The next step forward was to group oxides together, and to calculate the *mineral composition* from the chemical analysis. This told which minerals existed in the sand and in what proportions they occurred; so much free silica or quartz, so much feldspar, so much clay and so much hydrated oxide of iron. This, provided that the original chemical analysis was both accurate and complete, brought nearer an appreciation of the refractoriness of the sand; for the melting points of the various minerals were known. However, the property of refractoriness is dependent to a large extent upon the size of the particles; the smaller the particles the more readily they frit together and burn onto the casting, causing an unsightly product and resulting in high cleaning costs.

Describes Theoretical Clay

To obtain more information on this important point, chemical analysis has been carried to its logical conclusion, namely the examination of each grade separated from the bulk mechanical analysis.[1] Unfortunately, the time and money required for such complete examinations which often entail five complete analyses—is prohibitive except in research work, consequently few have been published and definite conclusions are hampered by lack of data.

Before we form any opinions based on the chemical constitution of sands, it will be advisable to consider the term *clay* as applied to the calculated mineral analysis.

In calculating such an analysis, the potash (K_2O), soda (Na_2O) and lime (CaO) each are allotted such amounts of silica and alumina as they require and are calculated to their respective feldspars. The remaining alumina is then calculated to clay. All the residual silica is recorded as quartz and any iron present is calculated to hydrated iron oxide. This theoretical clay has the composition Al_2O_3, 2 Si O_2, 2 H_2 O, and approaches more nearly to kaolin or china clay in composition than the more common clays.

General experience with clays shows that the sticky clays of high colloid content, which form useful natural bonds, depart considerably from such a composition while pure clays which approach the composition Al_2O_3, 2 Si O_2, 2 H_2 O, are more refractory though lacking in bonding properties. Consequently if one sand contains 5 per cent of calculated clay and another contains 10 per cent it may be assumed that the latter sand is twice as strong as the former. The reverse might feasibly be as near to the truth.

The importance of hydrated oxide of iron as a bonding medium now is realized, but here again the relation between the amount of this substance and its bonding value is variable.

J. E. Fletcher[2] puts forward an interesting hypothesis regarding the constitution of naturally bonded molding sands. From the consideration of a series of chemical analyses of fine sand, coarse silt, fine silt and clay grades, he deduces that the grain consists of a central nucleus of silica, surrounded by a layer of feldspars, outside which is a further layer of iron and titanium-bearing minerals; while the whole is enclosed in a coating of kaolinite, or pure clay substance.

Two objections present themselves against Fletcher's hypothesis; the first is that the feldspars forming the inner jacket must be so finely divided to enable them to be spread around a quartz nucleus, say 0.05 inch in diameter, that they would be unstable and would be rapidly degraded to kaolinite. The second objection lies in the fact that the inner coating of feldspars is separated by a layer of other material from its decomposition product kaolinite.

It would appear to the writer from his own observations that the following simplification of Fletcher's theory is nearer to the truth:

Formation of Sands

That the nucleus of the grains consists of either feldspar or quartz in varying percentages.

That the proportion of feldspar nuclei increases, in the majority of sands in the finer grades. (This is what could be expected as feldspars are much more readily attacked by natural agencies than are quartz grains. Further, the writer has found that the bond coating contains absorbed salts, etc., especially carbonic or humic acids, which will hasten the decomposition of feldspars).

That a mixed coating of kaolinite (pure clay substance) limonite (hydrated iron oxide) usually; hydraogillite (hydrated alumina) possibly; and extensively degraded iron, magnesium and titanium bearing minerals covers the nucleus of quartz or feldspar.

That this coating is rarely homogeneous; a thin pellicle or coating usually adheres to the nucleus and cannot be removed by washing.

That it would appear probable that the coating around the feldspars is thicker, richer in kaolinite and more firmly held on the rough, semidecomposed feldspar surface than on the smooth quartz grains.

Knowledge of the true constitution of naturally-bonded molding sands is scanty, and so complex is the subject that progress must be somewhat slow.

It is doubtful whether mechanical analysis preceded or followed chemical analysis as an early method of examining molding sands. On the other hand it is certain that the early work was

From a paper presented at the Paris meeting of the International Foundry congress.

1 Boswell. *Memoir on British Resources of Refractory Sands.*

2 *Journal*, British Iron and Steel Institute, Vol. 1, 1923. On some characteristics of molding sands.

limited, partly because of the limitations of the apparatus available, and partly because the importance of the chemical condition of the sand was not so fully realized as it is today.

From a knowledge of the percentages of sand occurring in the various grades, it is possible to say whether the sand is suitable for heavy or for light work. If the test is carried out under certain conditions, some idea is obtained as to the approximate value of the bond, and most important of all, information is gathered covering the venting properties of the sand. Much general information can be obtained by inference, but nothing absolutely definite can be concluded save only the bare statement of the percentages and the grades into which they fall.

The methods that have been used for the mechanical analysis of sands are briefly as follows:

1.—The sand is graded dry on wire sieves for 30 seconds on each sieve.

2.—The sand is graded dry on wire sieves until no further sand passes the various sieves.

3.—The sand is graded as in method 2 but water is employed to wash the sand through the various sieves.

4.—The sand is graded as in methods 2 or 3 but sieves with round punched holes, 1 millimeter, 2 millimeters, 5 millimeters and 25 millimeters in diameter are used instead of wire screens.

5.—The sand is graded by methods 1, 2 or 4 and the material passing through the finest sieve is examined by the subsidence test[1].

6.—The sand is deflocculated with dilute ammonia by shaking mechanically for 1 hour. It then is separated into various grades by means of an elutriator, the washed sand grade being subsequently dried and subdivided by a method as described in No. 4.

[1] For details see J. E. Fletcher, *Journal* British Iron and Steel Institute, Vol. 1, 1923.

Composition of Molding Sand

Molding sands consist essentially of more or less rounded grains of sand around which some bonding substance is displayed. Usually they consist of sand grains, silt grains and bond. The bond generally consists of two portions, one of which adheres firmly to the surfaces of the sand and silt grains, while the other, when moistened, is capable of further distribution over the surfaces of other grains.

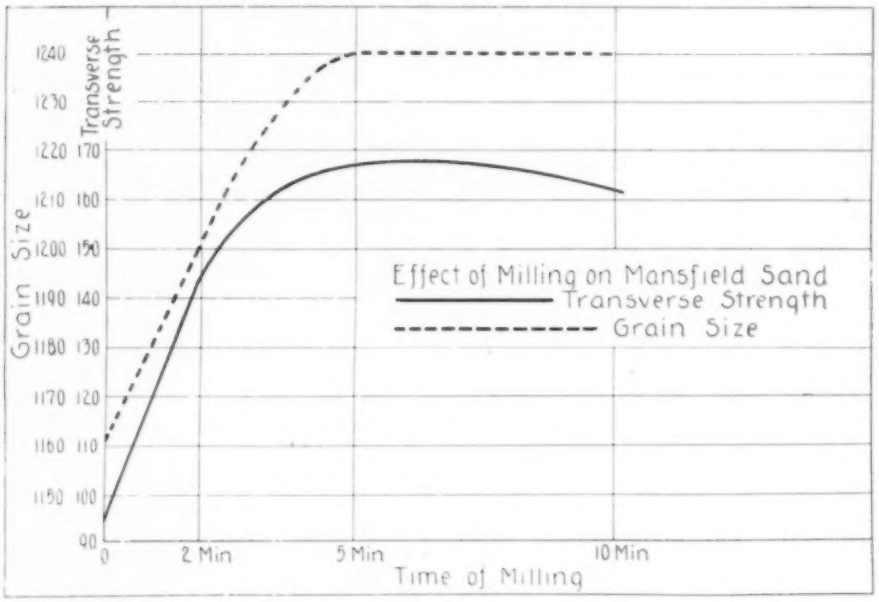
All dry sieving methods show percentages of silt and clay which are lower than the true values, because the fact that the sand is dry causes much of the silt and mobile bond to adhere to the sand grains. This coating naturally increases the apparent diameter of the sand grains causing many of them to remain on sieves through which they would pass if clean.

Method 1 has but one virtue; it is rapid. So far as the results obtained are concerned, they are so far from the practical truth as to be misleading.

Method 2 is a tedious test to carry out unless a vibrator is used; in any case it suffers from the defects referred to method 1.

Method 3 is better in that some of the bond coating is removed.

Method 4 removes an inaccuracy inseparable from wire sieves; a round aperture tends to grade to the mean diameter of the grains; a square one to the major axis.



EFFECT OF MILLING ON MANSFIELD SAND SHOWING VARIATIONS IN GRAIN SIZE AND TRANSVERSE STRENGTH

Method 5—Further useful information is here obtained concerning the finest material, so-called 200 or clay grade resulting from the dry sieving.

Method 6—Here deflocculation and shaking separate the bulk into sand grains coated with a thin and permanent layer of static bond; silt grains, similarly coated; and free particles of mobile bond.

The washing action of the elutriator separates the bulk into its constituent grades with considerable accuracy and check tests agree closely; a most desirable feature which is not always sufficiently appreciated either in routine or research work.

Crook's elutriator as used by the writer effects separation into the following grades:

Sand grade 1 to 0.10 millimeter (1/25 to 1/250 inch).

Silt grade, 0.10 to 0.01 millimeter (1/250 to 1/2500 inch).

Clay grade, less than 0.01 millimeter in diameter.

The separated sand grade is subdivided into coarse sand, less than 1 and more than 0.5 millimeter; medium sand less than 0.5 and more than 0.25 millimeter; and fine sand less than 0.25 and more than 0.1 millimeter by means of copper sieves with punched round holes.

The silt grade, unless it is so small in amount as to be unimportant is divided in the elutriator into coarse silt less than 0.10 and 0.05 millimeter; and fine silt, less than 0.05 and more than 0.01 millimeter.

The names and sizes of the grades are of course arbitrary, as indeed they must be in any case, and the writer cannot emphasize too strongly that the really active bonding material is considerably finer than 0.01 millimeter (1/2500 inch) in size.

While the elutriation of a washed silica sand would obviously be a waste of time; no other method of mechanical analysis can show us so completely the constitution of strong sands loams and clays.

At the risk of repeating the same thing in another section, the reasons why silt grade and clay grade should not be classed together as through 200 mesh or 200+, or clay will now be discussed.

Silt grades may cause trouble in several respects; mixed with sand grades they choke up the vent tending to produce blown or scabbed castings; they are invariably richer in chemical impurities than the sand grade, tend to frit more readily, and are in consequence liable to cause *burning on* troubles; further, they present a large surface which must be coated with bond if the strength of the sand is to be maintained. They

have only one virtue, they tool well from the molder's point of view.

In connection with the sieve test it is common practice to multiply the percentage of sand by the mesh numbers of the sieves through which they pass; to add these figures up; divide the sum by a hundred and refer to the result as the *fineness*. A similar course is pursued in determining the average grain size from the sieve test.

While there is, of course, no harm in performing these calculations, their results convey little, or no information that they would appear to be a waste of time. They tell us nothing about the bond or the refractoriness; and such information as they might appear to convey regarding the venting properties is likely to be misleading.

Reference to the work of H. A. Schwartz shows that sands of similar fineness may vary widely in permeability. It is difficult to see how either the fineness or the average grain size can be of use, either directly to the foundryman or indirectly through the medium of the research worker.

Nature of the Bond

In a naturally bonded molding sand, the grains are usually held together by one major factor and two minor ones. If we take a shore or dune sand, which consists of clean, more or less rounded grains, and moisten it with water, we are able to form it into simple shapes which fall again to a heap of loose sand as soon as they become dry. This weak bond is dependent upon the pressure of water and disappears as the water evaporates. It is due to the fact that the surface tension is greater between the water and the sand than between the individual molecules of water.

As this force can act only at the points of grain contact, its magnitude must depend on the number of grain contacts per unit volume, hence the finer the sand and the more irregular the grains are the stronger will this grain become. This is the only bonding agent used in the casting of pig iron on sand beds at the blast furnaces in many cases, principally on account of the difficulty of maintaining any other bond economically under such adverse conditions.

The second minor factor is the *sharpness* (the term is used here to denote angularity, not coarseness) of the grains. Sands composed of angular grains exhibit more surface, more points of contact and, with greater frictional resistance to formation, than to round grained sands, size for size.

Neither angular grains nor excessive moisture are desirable, and that the bond derived from these sources is slight, and preferably so, in a properly constituted molding sand. In the burnt-out silty floor sands, to be found on some molding floors, it is possible that the two factors discussed here do constitute a considerab.e percentage of such slight bond as exists, unless indeed the grains are held together by force of habit.

Table I

Specific Surfaces

Diameters of grains centimeter	Specific surface square centimeters	Remarks
1.0	3.14	
0.10	31.4	
0.01	314.2	Not in
0.005	628.4	colloidal state
0.001	3141.6	
0.0005	6283.2	
0.0001	31416.0	Colloidal
0.00001	314160.0	state

The major factor in the bond of a molding sand lies in the colloidal matter which constitutes a portion of what is commonly known as the *clay* and also adheres, in many cases to the sand and silt grain surfaces.

A full description of the nature and properties of colloids is beyond the scope of this paper. Those who are interested should refer to the extensive literature on the subject. Sufficient to say that colloidal properties are associated with minute particles and that such particles possess these peculiar properties because of the enormous ratio of their surface to their mass.

That those who have not previously considered this question of the ratio of surface to mass may obtain a clear idea of the subject, let us consider, for example, a cube of cast iron whose side measures 1 inch and whose weight is ¼ pound; its volume will be 1 cubic inch and its surface area will be 6 square inches.

If we split it into two halves, we expose two new surfaces each 1 square inch in area, making in all $6+2=8$ square inches of surface exposed, but we have neither altered the original weight nor the volume. Hence we have greatly increased the ratio of the surface to the mass.

If now we grind down 1 cubic inch of cast iron to powder we still have the same weight left at the end of the operation, but instead of having 6 square inches of surface we have something more nearly approaching a surface of 6 square feet.

The total surface displayed per unit volume of material is known as its *specific surface* just as the weight per unit volume of material is known as its *specific gravity*.

Table I shows approximately the rapid increase of the specific surface of rounded particles as the diameter of the grains diminishes. When these particles become so small that 1 cubic centimeter contains 10 square meters of surface, or expressed in English units, 1 cubic inch contains 200 square yards of surface, they commence to be of value for bonding purposes.

Describes Coagulation Phenomenon

The bonding materials usually found in molding sands are known as suspensoids or suspension colloids; their presence readily can be seen by shaking a strong molding sand with a large excess of pure water. If the water is in sufficient excess (100 times the weight of sand is usually enough) and if the water is sufficiently pure, these minute particles will remain in suspension for an almost indefinite period, rendering the water turbid.

The addition of almost any salt solution to the pure water will cause the colloidal particles to collect into groups of considerable size and settle out leaving a clear solution. This phenomenon is known as *coagulation*. The colloidal particles are also capable of attaching to their surfaces salts and other soluble bodies, and it is by virtue of this property of absorption that we are able to obtain some indication of the amounts of colloidal matter in molding sands by means of the dye absorption test. Absorption usually results in coagulation, which, when not desired, may result in erroneous results either in elutriation or in the subsidence test.

An unfortunate lack of knowledge exists as to the properties of the various colloidal substances existing in the bond of molding sands, and while we are able to produce excellent castings without such knowledge, it is at least possible that we could produce better and cheaper castings were our knowledge more extensive. For instance, we know something about the mixing of sand grades to obtain the best venting properties, but we know little about mixing bonds to obtain the greatest strength and useful life.

Space does not permit of any consideration of organic bonding agents such as linseed oil, molasses, etc.; mineral bonds such as are found in naturally bonded sands will alone be discussed. Much knowledge remains obscure regarding the chemical and physical properties of these natural bonds. Originally they were classed as *clay* but modern investigation has shown that other constituents occur, and may be of great value.

How then can we estimate the strength of the bond? E. W. Smith in a paper read before the Chicago Foundrymen's club, suggests that after sedimentation of the sand with water, the bond can be estimated by measuring the height of the layer of clayey matter overlying the column of sand grains. However,

the writer has shown[4] that there is little or no relation between the amount and strength of the bond in different sands or even in the same sand in different conditions.

Ashley Franklin, Saunders, Hanley and Simmons, have conducted researches on what is now known as the dye absorption test. This test is based on the fact that certain substances, some of which are dyes such as crystal violet, are adsorbed by the colloids present in the bond. In practice more dye is added than the bond can take up, the excess is estimated colorimetrically and the amount used (expressed in parts of dye absorbed per 100,000 parts of sand) is taken as the *bond value*. The various colloids which constitute the bond have widely different bond values and natural bonds are usually so complex as to render the study of their component parts by this method impossible.

Limitation of Tests Values

Work carried out by the writer tends to show that the once despised iron oxide, when colloidal, is the most powerful adsorbent. The test itself is a lengthy and tedious operation, calling for a certain amount of manipulative skill. Discordant results may be obtained unless many precautions are taken, and the test is subject to certain limitations some of which follow:

The bond value may be considerably altered by mechanical work such as milling, for under these circumstances, while the amount of colloidal matter is not actually increased, the amount so distributed as to be affected by the test is increased and a higher bond value is obtained.[5]

The test is of doubtful value with used sands, as the colloidal matter may be wasted by burnt clay in steel molding sands, and again in green sands for gray iron, the porous coke resulting from the heating of the coal dust will adsorb dye, giving a positive value on test, while it actually will adsorb a certain amount of colloidal matter into its pores, and has in fact a slight negative value as regards mechanical strength.

The dye adsorption test can only, under the best circumstances, evaluate the total amount of bond present, it does not tell us how this bond is distributed and hence gives a poor indication of the true mechanical strength or cohesiveness of the sand, which is the most important practical consideration.

Further, this test takes no account of two factors which have a great bearing on the cohesiveness of the sand, namely the surface to be coated with bond and the number of grain contacts per unit volume. As already explained, the smaller the grains the greater the surface, and hence the thinner the coating given by a definite amount of bond. However, this may be somewhat compensated by the fact that the number of grain contacts per unit volume increases along with the specific surface.

Some definite data on this matter is desirable. Fig. 1 shows diagrammatically the influence of milling upon the bond value and the traverse strength. In dealing with such small quantities of sand as are available from time to time in research work, the dye adsorption test is of great value, principally because there is nothing to replace it.

The most valuable indication of the practical strength of the bond is given by either the transverse, or preferably the overhanging test as developed by R. J. Doty. This test which is indicated in part II of this article takes account of both the quantity and quality of the bond, and also of the distribution of this bond over the available surface and of the number of grain contacts per unit volume.

4. *Journal* of the British Iron and Steel Institute, Vol 1, 1922.

5 See the writer in the Journal of the *British* Iron and Steel Institute, Vol. 2, 1922, also Harrington, McComb and Hosmer. Proceedings of the American Foundrymen's association, 1923.

Book Review

Mechanical Engineers' Handbook, second edition, Lionel S. Marks, editor-in-chief. Leather, 1986 pages, 4½ x 7 inches, published by the McGraw-Hill Book Co., New York, and supplied by THE FOUNDRY for $6.00, net.

This handbook represents the work of 50 specialists and is intended to supply the practical engineer and student with a reference book which is authoritative in character, and covers the wide field of mechanical engineering in a comprehensive manner. In the second edition the revisions generally have been made by the original contributors. The subjects which have been revised extensively are hydraulics, heat, iron and steel, nonferrous metals and alloys, steam boilers, internal combustion engines, aeronautics and air compressors.

The section devoted to materials of engineering is of special interest to foundrymen, as it covers the following subjects: Classification of castings and the specifications covering gray iron, malleable and steel castings. The nonferrous metals and alloys and the strength of such materials at high temperatures, foundry materials, layouts and costs. Other sections of the volume treat of machine shop practice, mechanics of rigid bodies, stresses in frame structures, power generation, building construction, etc.

The second edition endeavors to combine what is considered at the present time the best engineering theories and practices and those branches which are of most interest to mechanical engineers. A convenient feature of this volume is the use of thumb tabs which assists the reader in locating the detached contents of any section.

Sand Sticks to Dryer

Question: Recently we have experienced considerable trouble through oils sand cores sticking to the dryers and will appreciate any information on how to prevent a continuation of this condition. Do you know of any material that can be rubbed on the dryers to prevent the sand from sticking?

Answer: Your trouble may be traced to one or two probable causes. Your sand may be too wet, either through the use of too much water or too much binder or your dryers may not be provided with vent holes for the escape of gas and steam from the under face of the cores. You do not need to rub any preparation on the face of the dryers to prevent the sand from sticking. If the sand is mixed fairly dry and in the proper proportions it will not stick. The tendency on the part of coremakers as a class is to use an excessive amount of binder to produce a hard firm core that may be handled with impunity. The coremaker usually is only one of the many cogs in the industrial machine and naturally he is not particularly interested in the other factors that enter into the production of castings. He does not want to see any broken cores and therefore he is tempted to use an excess of binder.

Where prefectly dried sand is available the amount of oil binder added is not sufficient to hold the sand in shape after it is turned out of the corebox. Water must be added and since well dampened sand will stand up better than sand which is drier, the coremaker is confronted with the temptation of adding more water than is necessary. Where either water or oil or both are present in excessive quantity they are driven partly by heat and partly by gravity to the lower face of the core when the heat first is applied in the oven. The result is a film of oil and water that condenses on the face of the drier and acts as a form of paste in uniting the sand to the dryer. Under certain conditions it is feasible to use plain dryers without perforations. In other cases vent holes in the dryers are an absolute necessity and in the great majority of cases they are advisable as a precautionary measure in the event that occasionally a batch of sand will come from the mixer a little damper than usual.

Fasy & Hannas Co., foundry and patternmakers' supplies, has occupied its recently completed building at 5315 North Second street, Philadelphia.

Iron Supply Governs Location

Malleable Foundry in Michigan Chooses Site Near Source of Charcoal Iron Production—Inter-Plant Transportation Features Carefully Planned—Built With View to Extensions

TRANSPORTATION usually has a large share in determining the location of a new manufacturing plant. This is particularly true in the iron and steel industry where ore and coke must be brought together with a lesser quantity of limestone to make pig iron. The proximity of Pittsburgh to the rich coal field of Connellsville gave it its prestige in the early days of iron and steel making in this country, although the ore had to be brought from a great distance. One factor which helped to decide that the ore be brought to the coke instead of the coke to the ore was the proximity to Pittsburgh of the market for the finished material.

Until recent years foundries have been located mainly with reference to the consumer. Of course, manufacturing plants tried to have the foundry in the same plant, or at least in the same city, as the machine shop, and jobbing foundries did little business at a great distance from the city in which they were located. Now, however, castings in some cases are shipped hundreds of miles from the city in which the foundry is located. This is true particularly of malleable iron jobbing foundries as their product often is shipped to many customers in different localities. Other considerations frequently outweigh that of a proximity to the customer in such cases. An interesting example of this is shown by the Cadillac Malleable Iron Co., Cadillac, Mich. This company ships its castings in some cases hundreds of miles and secures its coal from the far off fields of West Virginia, but it trucks its pig iron from the blast furnace of the Mitchell-Diggins Iron Co., on the property immediately adjoining it, while all the core sand it requires lays on its own property.

Use Charcoal Pig Iron

The two latter considerations are deemed to be big assets for the company, especially as the controlling interests of the blast furnace and the casting companies are closely identified. Another feature which makes the proximity of the blast furnace advantageous is that it produces charcoal pig iron which forms the basis of the metal cast by the Cadillac company, no coke pig iron being used. Looking into the future, the company anticipates the use of hot metal when several air furnaces are in operation in the foundry. Also the waste gases from the blast furnace offer cheap power when burned under a steam boiler. The sand on the property lies approximately 6 feet under the surface in a bed 8 to 20 feet thick. The hole left by sand taken out for use in making cores provides a ready means for disposing of the refuse which always is such a problem in the foundry.

Fig. 4 is a plan of the grounds showing the present buildings and the proposed extensions, the former indicated by solid lines and the latter by broken lines. The plans were made by Frank D. Chase, Inc., Chicago, and the buildings and furnaces were erected by individual contractors, the company acting as general contractor. At present one air furnace of 15-ton capacity is installed in the middle of the center bay of the molding department. This department is in a building separate from the annealing room as indicated in Fig. 4. It is divided into three bays. One bay is devoted entirely to molding, while the center bay contains the melting furnace, and the coreroom is located in one corner of the third bay. All of the space not otherwise occupied is fitted for molding with machines made by the R. J. Teetor Co., Cadillac, 31 floors in all being provided.

The floors in the foundry, except the aisles are made of paving brick set on sand and surrounded with ½-inch thickness of concrete. The aisles are paved with wood blocks as is the entire annealing room. The paved floor and aisles provide a more level surface for the operation of the sand-cutting machine than would be the case were the floor made of sand as in many foundries. The wood block in the aisles and on the floor of the annealing room provides easy traction for the trucks.

A corridor leads from one of the aisles

FIG. 1—CASTINGS ARE CARRIED FROM THE FOUNDRY TO THE CLEANING DEPARTMENT IN TRAINS OF BUGGIES DRAWN BY THE BATTERY TRUCK USED FOR CHARGING THE ANNEALING OVENS

Laboratory Report of Tests

Sample	Diameter inches	Tensile strength pounds per sq. in.	Elongation per cent in 2 in.
170-3	0.650	57,190	24.0
180-2	0.650	55,535	18.0
190-3	0.665	55,440	16.5
199.2	0.685	55,555	12.0
210-1	0.685	61,056	16.5*
220-1	0.655	55,835	14.0

*Broke at punch mark at fillet.

of the foundry department to the cleaning and annealing building, allowing the castings readily to be transported from one building to the other. At present four annealing ovens are in operation, but four more will be installed later in an extension on the opposite side of the annealing building. This narrow space is indicated on the drawing. The next unit of casting and annealing buildings also is indicated.

Only four of the ovens have been built to date because the foundry is not operating to capacity although nearly all the molding floors are being operated. This is due to the fact that all the men except R. J. Teetor, secretary and general manager of the company; the superintendent, and two foremen, are entirely new at foundry work. Not only does this cause slower molding operations, but results in a larger molding loss than normal. It is expected that when the molders and other workmen become thoroughly familiar with the work and a full complement of molders are working, the output will be doubled. At the time this article was prepared, two 8-ton heats are taken off, whereas the capacity of the melting furnace is 15 tons.

FIG. 2—A SPACE FOR LINING THE LADLES HAS BEEN PROVIDED BACK OF THE MELTING FURNACE—NOTE THE BULL LADLES ON BUGGIES

The operation of the foundry can be understood by following a heat through the shop. The pig iron, when it is brought from the blast furnace on trucks is dumped on two sides of a concrete runway. It then is loaded on buggies drawn by a tractor made by the Clark Tructractor Co., Buchanan, Mich. As it is moved to the melting furnace the iron is passed over a 6-ton platform scales and is weighed. It then is dumped into charging buckets placed along the main aisle near the furnace. Some of these may be seen at the left, Fig. 3.

Coke is unloaded by 24-foot conveyor which is carried by a chain fall on a trolley as shown in Fig. 7. The one end is dropped into the coal car and a motor operates the conveyor belt which carries the coal and drops it on the pile at the end of the conveyor. Current is brought to the motor through a lead wire which taps into any one of the plugs located on the wooden posts. At present the coal is wheeled into the foundry. However, this is only a temporary arrangement as it is planned to install a powdered coal system all through the shop for melting and annealing when operations are increased enough to warrant the expenditure required for coal powdering equipment. The conveyor was furnished by the Chicago Automatic Conveyor Co., Chicago.

Metal is charged into the melting furnace by a 5-ton traveling crane made by the Whiting Corp., Harvey, Ill. This crane covers the center bay of the shop. It carries the charging bucket by three chains, two hooked to the two corners at the rear and one to the middle of the open front of the bucket. The bucket, which holds 2 to 3½ tons of metal, depending on the bulk, is on the bottom of the furnace after three of the bungs have been removed, and the chain at the open end of the bucket is unfastened by a trip. Then as the chains are raised by the crane the rear end of the bucket is lifted and the contents slide out into the furnace. The object of this method of charging is to obtain the advantages of mechanical charging and still injure as little as possible the walls and bottom of the furnace.

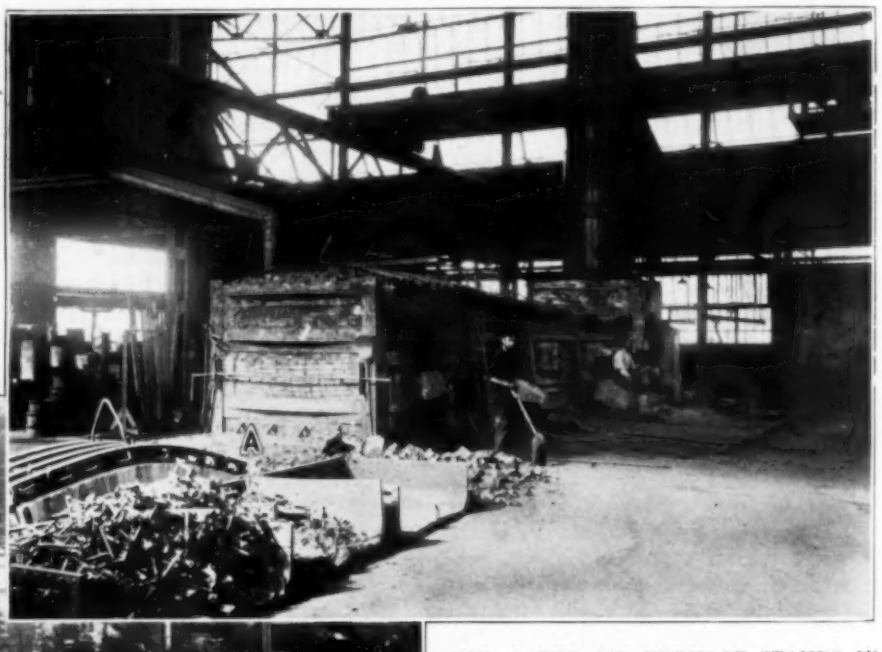


FIG. 3—THE AIR FURNACE STANDS IN THE CENTER OF THE SHOP

It is not necessary to remove more bungs for charging, as the bungs are wide and of a special design. Both 9 and 12-inch brick are used, in alternate rows, one row of four 9-inch brick followed by a row of three 12-inch brick. In this way the brick in each row cover the joints of the brick in the rows on each side of it. The furnace design was made

by the firm of Holcroft & Co., Detroit.

A blower operated by a 15-horsepower motor and mounted on the roof frame of the building near the furnace supplies air for combustion. This is carried to the ash pit of the furnace and to the tuyere blast by a pipe shown at the left, Fig. 3. The ash pit is sealed with fireclay when the heat is started and after the heat is tapped, the iron slabs in front of the pit, as shown at *A*, Fig. 3, are raised by the crane. Then the ashes are cooled by a spray of water and removed before the next heat is started. One man is required to fire the furnace and a melter and helper look after its operations. Their work is facilitated by ladles may be seen in Fig. 2, which shows the space behind the furnace allotted to lining the ladles. The buggy is pushed along by a handle attached to the frame and the ladle is tilted forward or backward by a handle attached directly to it. In this way the weight of the ladle rests directly on the buggy. Another form of ladle is used for special purposes. This ladle which, like the other one, holds about 200 pounds of metal, is supported on one end of a frame carried on the axle of a two-wheeled buggy. The other end of the frame, which is attached at right angles to the axle, carries the handle by which the buggy is moved. Thus the operator must balance from the furnace and give a basis for calculating the charge for the following heat, as all the sprue from a heat is used on the second heat succeeding it. Sulphur and phosporus are determined only occasionally as the sulphur in the coal is low and little of this element is taken up by the iron in meeting in the furnace while the amount of phosphorus in the pig iron determines the amount left in the iron going into the casting.

Take Temperature Readings

Not only is the chemical composition of the metals watched closely, but temperature readings of the metal are taken at different stages of the melt, and as the

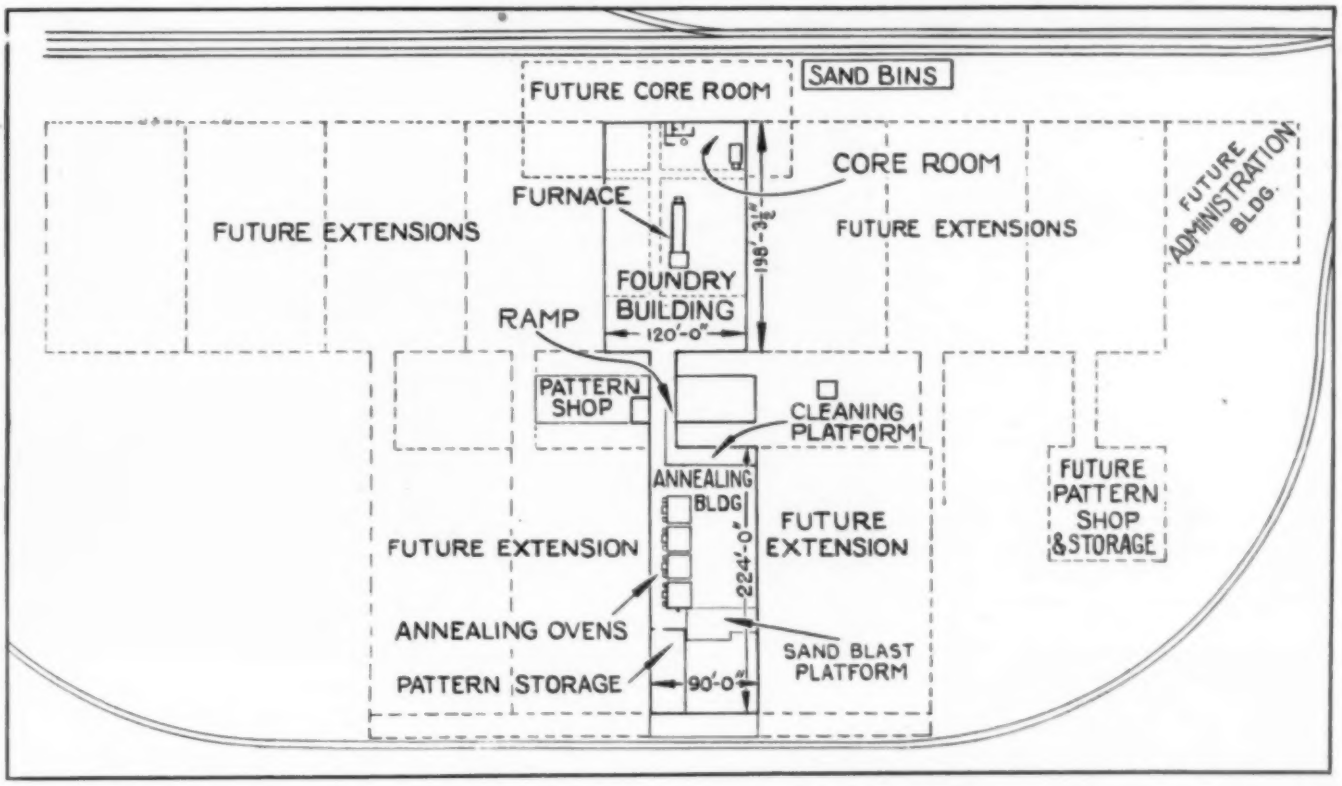


FIG. 4—PLAN OF THE PRESENT BUILDINGS AND THE PROPOSED DEVELOPMENTS—THE BLAST FURNACE SUPPLYING THE PIG IRON IS ON THE ADJOINING PROPERTY

drawing off the slag into buckets which are wheeled away instead of pulling it on the floor as is sometimes done in malleable shops.

Describe Ladles Used

The first heat is tapped at 10:45 in the morning and the metal is all poured by 11:45, at which time the shop is closed for lunch. The second heat is taken off at 4:30 in the afternoon. The first metal tapped is used to heat the ladles and is poured back into the furnace. After the preliminary heating of the hand ladles a few molds are poured from iron tapped directly into the hand ladles. Then when they become thoroughly heated the iron is brought to the molding floors in bull ladles, carried on trunions on wheels, from which it is poured into hand ladles for the smaller castings. Some of these the load of the filled ladle, which in the buggy first described rests on the axle. Another claim made for the buggy first described is that a spring, provided between the axle and the ladle on both sides, prevent excessive shocks as the ladle is pulled over the floor.

Before entering into a discussion of the molding it will be well to consider the metal. Charcoal pig iron is thought to give a metal with less shrinkage and which is more homogeneous than when coke iron forms the basis of the mixture. Low shrinkage lessens the tendency of the castings to crack and reduces the amount of metal required, as sprue can be made with smaller sections. The iron is watched carefully, silicon, manganese and carbon determinations being made on every heat by the chemist at the blast furnace. These are reported before the next heat is taken metal flows from the furnace. These readings are made by an optical pyrometer designed by the Leeds & Northrup Co., Philadelphia, a young man who never before had any experience in metallurgical work taking the readings.

The finished iron has the following composition: Silicon 0.75 to 0.90 per cent; sulphur 0.04 to 0.05 per cent; phosphorus 0.19 to 0.20 per cent; manganese 0.20 to 0.25 per cent; total carbon 2.40 to 2.60 per cent. Its tensile strength is shown in the accompanying table. The figures are from a report of the Detroit Testing Laboratory, Detroit.

Like many other foundries, the Cadillac foundry uses the labor in the chipping and cleaning department to assist in pouring off. When a heat is poured the chippers and grinders come to the foundry and shift weights and dump molds to expose

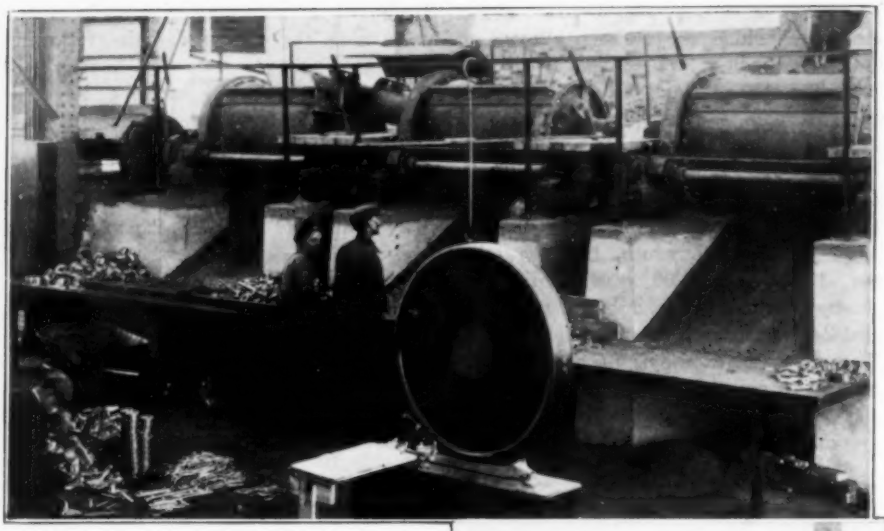


FIG. 5—CASTINGS ARE DROPPED FROM THE TUMBLERS TO THE CHIPPING BENCHES

the castings and allow them to cool. The crew which clears the floors comes in the morning in time to carry the iron from the furnace to the molding floors in the bull ladles when the first heat is tapped. After the heat is off, this gang shakes out the castings; knocks off the sprue, throwing the castings into the buggies which are stood in the aisles; edges up the sand piles, and then cuts the sand with a cutter furnished by the American Foundry Equipment Co., New York. It is then time for the afternoon heat, and this crew operates in the same manner as for the morning heat, staying in the shop until all the sand is cut.

Molds are made on machines of the suspended type each machine traveling the full length of its floor on an I-beam. The construction may be understood from Fig. 13. The illustration shows the legs B lifted so that the machine can be moved over a floor of molds. This is convenient when all the molds on a floor are not poured, or the molder has not reached the end of his sand row when the heat is poured. This is better understood when it is explained that the sand is arranged in a long row the entire length of the molding floor. The molder starts at one end using the sand and placing the mold immediately behind him, moving the machine along as the sand pile diminishes and the space at the rear becomes filled with molds. Thus he is not required to walk any distance with the molds and the sand is always convenient. If he has not worked to the end of his sand pile by the time the heat is poured, he continues in the same line after the heat is poured. Then when he comes to the end of the floor he raises the legs of the machine as shown in Fig. 13, and pushes the machine over the molds to the beginning of the sand pile which by that time has been cut. When molding, the feet of the machine rests on the floor. As shown in Fig. 13, a riddle is attached to the machine and swings over the mold for riddling the sand and then back out of the way.

FIG. 7—STOCK YARD SHOWING MEANS USED FOR HANDLING COAL

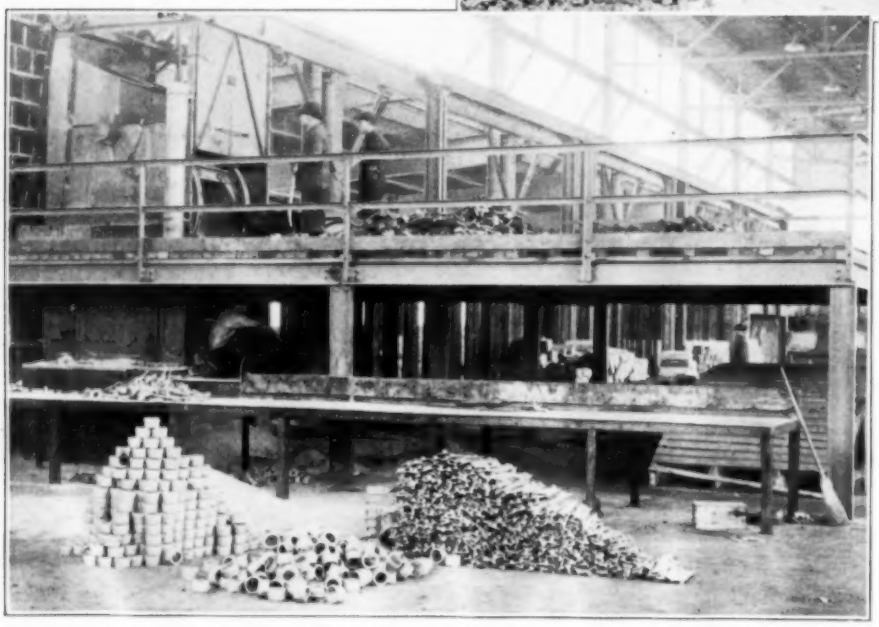


FIG. 6—A SAND-BLAST BARREL CLEANS THE SOFT IRON CASTINGS WHICH THEN ARE DROPPED TO THE BENCH BENEATH

Many of the molds are made in a snap flask and the joint covered with a jacket for pouring, while others are rigged specially. An instance of a special rigging is shown in Fig. 12, which indicates molds for a differential housing for the Studebaker automobile. After the sand is sifted and shoveled into the mold, squeezed and struck off, the bottom board is put on and the mold set on the floor. Two cores, *C*, Fig. 12, are set in the mold. These cores are fitted as indicated at *D*, and form a cover for the mold, no cope being used. The cores in place are shown at the right in the illustration, and

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

PROPERTIES OF SPECIAL WELDING RODS

(*Continued from Data Sheet No. 524*)

MANGANESE BRONZE

No. 1

Copper	61.0—57.0
Zinc	37.0—41.0
Manganese	0.3 to 0.5 %
Aluminum	0.05 to 0.15%
Other elements and impurities	1.35 to 1.65%

Uses

For the general welding of brass sheets, plates, shapes and castings.

No. 2

Copper	61.0—57.0
Zinc	37.0—41.0
Iron	0.5 to 1%
Other elements and impurities	1 to 1%

No lead or aluminum allowed.

Uses

For welding malleable iron, bronze and brass where high tensile strength is required.

Material

Cast No. 1 in round sticks.
Cast No. 2 in hexagon sticks (the given dimension being that across the hexagon.) In lengths not less than 12 inches.

Physical Properties

Rods shall be straight and of homogeneous structure.

Surface Finish

Rods when cast, shall be pickeled or rattled.

Recommended Sizes

$\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$ inch diameters.

(*Continued on Data Sheet No. 526*)

PROPERTIES OF SPECIAL WELDING RODS

(*Continued from Data Sheet No. 525*)

COPPER

To contain 0.03 to 0.06 per cent phosphorus, or silicon 0.8 to 1.2 per cent and not over 0.4 per cent impurities, the rest to be copper.

Uses

For general welding of copper sheets and rods.

Material

Drawn, when cast, rods not to be less than 12 inches long.

Physical Properties

Rods shall be straight and of homogeneous structure.

Surface Finish

The surface shall be smooth and clean.

Recommended Sizes

$\frac{1}{16}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, and $\frac{3}{8}$ inch diameters.

ALUMINUM

No. 1

Aluminum	99.0 per cent

Uses

For the welding of aluminum where great ductility is required.

No. 2

	Per cent
Aluminum	92.0
Copper	8.0

Uses

For the general welding of aluminum.

Material

Drawn or cast.
When cast, rods shall be not less than 12 inches long.

(*Concluded on Data Sheet No. 527*)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

SUBSIDIARIES — GRINDLE FUEL EQUIPMENT CO.-SWENSON EVAPORATOR CO.

WHITING CORPORATION

FORMERLY
WHITING FOUNDRY EQUIPMENT CO.

CRANES-FOUNDRY EQUIPMENT
RAILWAY SPECIALTIES

HARVEY, ILL., U.S.A.
(CHICAGO SUBURB)

May 31, 1923.

The Foundry,
E. 12th & Chestnut Sts.,
Cleveland, Ohio.

Gentlemen:

We have advertised in The Foundry for the past 25 years; in fact, we were one of the first concerns to advertise in the medium. Through these years of advertising, we feel that more business can be traced direct to our advertisements in The Foundry than any other methods we have used in trade paper advertisements.

We can say without hesitation, that we consider The Foundry the best medium to use either for old or new concerns desiring to tell their story to the foundry trade throughout the world.

During the past two years of depression, we materially cut our entire advertising appropriation, but during this time, maintained our two full pages in The Foundry.

It is with much pleasure that we recommend to anyone desiring to reach the foundry trade, to advertise in The Foundry - not only that it is a most efficient trade paper, but that their entire staff is most efficient, and a pleasure to work with.

Yours very truly,

WHITING CORPORATION

R. H. Bourne,
V. P. & Sales Mgr.

RHB*IB

a mold, weighted and ready to pour, is shown back of it. The pouring gate and the riser are indicated clearly in both the molds and the cover core.

All cores are made in a small core department in one corner of the shop, as indicated in Fig. 4. Both girls and men are employed in this department. The sand is dried on a steam coil and then mixed in a machine made by the National Engineering Co., Chicago, both dry binder and oil being used. A core oven of the car type with a compartment of 18-inch shelves on the side was furnished by the Foundry Equipment Co., Cleveland. The cars are moved by a hydraulic lift truck supplied by the Cowan Truck Co., Holyoke, Mass. The shelf oven is used to bake cores which are wanted quickly.

Castings, as has been noted, are taken from the sand and thrown into buggies standing in the aisles. When full these buggies each of which hold approximately 1 ton, are hooked in a train and drawn to the balcony in the annealing and cleaning building, where they are tumbled. The electric battery truck, made by the Elwell Parker Electric Co., Cleveland, used for charging the annealing ovens, readily pulls a half dozen of these buggies up the ramp leading to the cleaning balcony. A train of these buggies, starting up the ramp, is shown in Fig. 1. The method of connecting the buggies is indicated more clearly in Fig. 11. When not hooked to another buggy, the buggy stands on a foot, *E*, Fig. 11. The battery truck carries a number of couplings, *F*, the same illustration. These couplings consist of a wheel carrying a yoke with a hook and a short length of pipe. A casting with two holes for coupling to the next buggy is attached to the end of the pipe. For pulling by hand the pipe is extended and has a cross piece at the end as shown in Fig. 10.

The castings are dumped from the buggies into tumbling barrels when they reach the balcony, or elevated platform. This is accomplished by a fall chain which is carried on light jib crane. After the castings have been tumbled the cover of the barrel is lifted off as shown in Fig. 5, and the barrel is turned so as to allow the castings to drop out and fall down the chute to the table below to be chipped. At the time the photograph was taken the chippers dropped the casting on the floor because enough buggies to handle the work had not been secured, but now the castings are placed into buggies and carried to the annealing oven to be packed, after being weighed on the scales shown in the foreground. The extent to which the buggies enter into the company's transportation system may be realized when it is stated that 200 are required. The scale is of 12,000 pounds capacity. This is considerably more than would be required by the weight of material handled at one time, but it was felt a heavier scale would have better wearing qualities and stand the rough usage of the foundry better than a lighter scale. This scale together with a similar one in the shipping department were furnished by the Toledo Scale Co., Toledo, O.

FIG. 8—RECORDING INSTRUMENTS OF THE PYROMETERS USED IN ANNEALING ARE ATTACHED TO THE SIDE OF THE END OVEN

Castings are ground on five double stand grinders, one 24-inch, two 18-inch, and two 14-inch. By having grinders requiring different size wheels the wheels on the larger grinders can be transforred to the smaller ones when they become worn.

The annealed castings are cleaned in a sand-blast barrel at the opposite end of the shop from the hard cleaning section. The barrel is elevated and the sand is carried by air from a bin at the rear. This equipment was furnished by the American Foundry Equipment Co., New York. At present the castings are brought to the elevated platform by the battery truck, similarly to the way they are carried to the platform in the hard iron section. However, it is planned to install a crane as soon as the second melting furnace is built. The sand-blast barrel is operated 24 hours a day and then cannot clean all the castings, the excess being sent to the hard iron department. Here the three barrels are operated 12 to 18 hours a day. A straight-

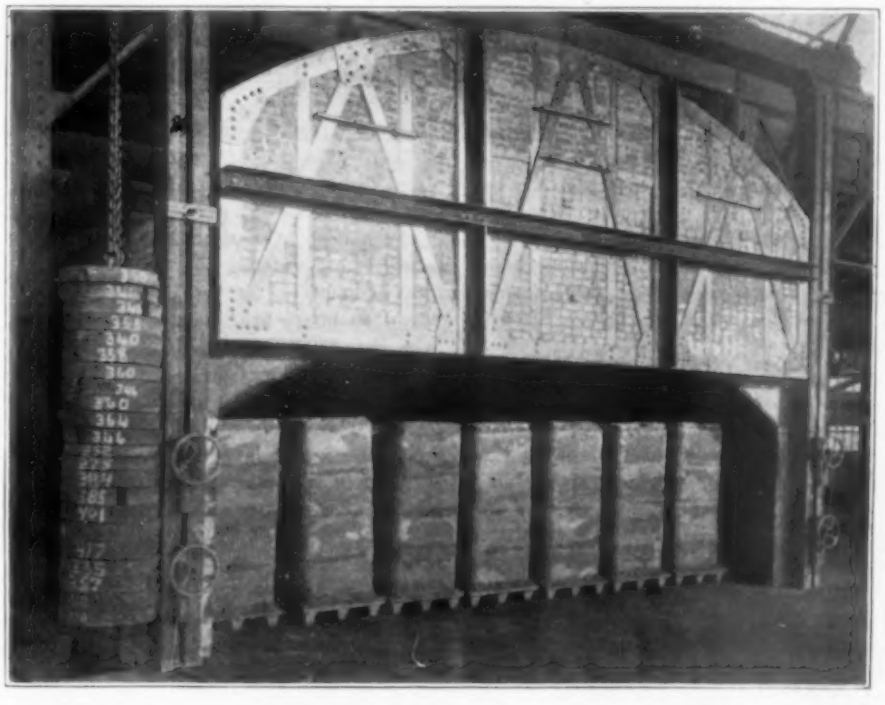


FIG. 9—ANNEALING OVEN CHARGED AND READY TO BE CLOSED—NOTE THE COUNTERWEIGHTS FOR HELPING TO RAISE THE DOOR

ening hammer is located in one corner of the cleaning department. The shipping-room adjoins the soft cleaning section and castings are readily sent there in trucks. Small orders are shipped in bags, the castings being put into the bags which are held open by iron stands consisting of rings held on three legs.

The annealing department is immediately between the hard iron and the soft iron cleaning departments so as to prevent unnecessary hauling. Four ovens have been provided to anneal the castings from the one melting furnace now installed. These ovens are on one side of the building, as indicated in Fig. 4. Each has a capacity of 40 tons of castings, which are packed in hematite ore secured from the blast furnace company. At present they are hand fired, but it is the intention to introduce powdered coal. A fire box is built at each corner at the end of the oven. The doors for these may be noted at the right, Fig. 8. In this case the first oven has finished an anneal and the doors have been luted with fireclay to prevent too rapid cooling.

FIG. 10—BELOW—ATTACHING THE DOLLY TO A BUGGY

FIG. 11—METHOD OF COUPLING THE BUGGIES IS CLEARLY INDICATED, ALSO THE MEANS FOR HOLDING THE DOOR OF THE ANNEALING OVEN TIGHT TO THE FACE OF THE SIDES AND ROOF

Door Well Supported

A particularly interesting feature of these ovens is the large 20-foot door, with the means provided for handling it. The steel frame construction of the door is clearly indicated in Figs. 9 and 11. Here may be noted the two fabricated supports extending vertically near the center of the door, and the channel extending horizontally across the middle. Special balancing also is provided for each of the three points at which the chains for raising the door are attached. Two of these chains are carried by pulley wheels above the furnace to a stack of weights, that may be noted at the left, Fig. 9. The center chain is carried to the opposite side of the oven. The door, which is made of a light weight insulating brick made by the Armstrong Cork & Insulation Co., Pittsburgh, is so nearly balanced by the weights that a man can raise it by pulling on the chain tackle which connects with the center chain. Four steel clamps attached to the sides of the furnace can be turned so as to fit against the door, and then are pressed tightly to hold the door against the oven frame by wheels turning on a tie bolt. Tie rods fastened to the front plate of the furnace and fitted to the back by springs brace the oven longitudinally.

The anneal is conducted at a low temperature and extends over a long period, the complete cycle requiring 11 days. About 50 hours are spent in bringing the oven to 1500 degrees F., at which temperature it is held for from 65 to 75 hours, depending upon the number of stacks of pots charged. When the pots are stacked close together a longer time is required for the temperature to penetrate to the center than when a large space is left between the stacks, therefore the longer time required after the oven itself is up to temperature. The oven is cooled slowly, at the rate of 5 degrees Fahr. an hour, until the temperature of 1300 degrees has been reached. Then the damper in the stack is opened slightly to increase the cooling rate to a point between 8 to 10 degrees per hour.

To insure accurate temperature regulation four double-recording pyrometers, built by the Leeds & Northrup Co., Philadelphia, have been installed. The recording instruments are mounted on the side of the end oven, as indicated in Fig. 8. These instruments can be attached to couples in any of the ovens so that readings can be recorded at 8 places in one oven if desired, or in two places in four ovens. Holes for the couples are left in each oven as follows: One in the roof; one in the door, as shown at *H*, Fig. 11; and three on each side, equally spaced 18 inches from the bottom. The temperature along the side is regulated by partly closing the down flue near the hottest point with brick. Five of these down flues are provided on each side of the oven and lead to large flues which run under the floor. The latter are 16 x 20 feet in cross section.

Seek Comfort of Workmen

While the shop was designed for the economical production of castings the comfort of the workmen was sought. Besides the usual toilets and wash rooms, a blower was installed in the roof girders to blow air through the foundry. In the summer this ventilates the shop, and in winter the air is blown over steam coils to help to heat the building. Heat also is furnished in both the foundry and the annealing room by wall radiators supplied with waste steam from the

boilers in the power house. Water for the foundry is secured from a well dug on the property. Drinking fountains are scattered through the shop and a spigot for wetting down the sand is located at every column in the foundry building. Compressed air is supplied at 80 pounds pressure by a two-stage compresser made by the Ingersoll-Rand Co., New York. This is located in a small building between the foundry and the annealing department, which opens onto the corridor between.

Molding Sand Used Twice In Same Day

Question: We make soil pipe and fittings and for lack of room are contemplating putting our foundry on double turn. We should like to have your opinion on whether it is practicable to use the same sand twice in the 24 hours.

Answer: Whether sand may be used twice in 24 hours is best answered by the statement that in foundries where continuous pouring goes on the same sand is used over again every one, two, or three hours. In fact in the foundry of the Westinghouse Airbrake Co., Wilmerding, Pa., where the molds are poured on a conveyor, the sand that forms one mold is shaken out, mixed, sprayed and ready to enter a second mold 20 minutes later. However, in your case many factors must be considered in addition to the actual usability of the sand. For example, if your foundry is operated in the customary manner, that is, if all the molds are placed on the floor and poured during the closing hour or two in the afternoon, it is apparent that a night gang can not come in and start molding immediately. A suitable interval must elapse to allow the greater part of the steam to escape and to cut the sand over properly. If the day gang finishes pouring and shaking out by 4:30 the sand may be wet down and allowed to stand until 5:30. Then it may be cut over and the night gang may start in molding at 7 p.m. A similar interval after 4:30 a.m. will be sufficient to place the sand in proper working condition for the day gang.

The foregoing outline presupposes the presence of two cupolas, one for day and one for night service. Increased output may be secured on your present floor space, from one cupola and without putting on a night gang by rearranging the work so that the molders confine all their time to making the molds. Other men can be trained to pour the iron, shake out the castings and cut the sand. If your present cupola has a capacity for melting all the iron required for a day's work in one or two hours it may be lined down to a point where the melting speed per hour will equal the amount of iron required to pour all the molds put up in the same time. In this manner melting can commence in the morning and continue throughout the day. By pouring the molds on the various floors in regular order it is apparent that only a small number of molds will be hot at any given time and the sand can thus be reconditioned in small quantities without interfering with continuous operation.

Makes Casting Crucibles for Platinum

Crucibles from which platinum can be successfully cast are now being made at the U. S. bureau of standards. Thorium or zirconium oxide is used. It is ground to a powder and mixed with water and gum. Then it is poured into a plaster mold which absorbs the water from the outside of the mass of slip. When the part thus dried is thick enough the liquid interior is poured out and the crucible dried and fired.

Platinum is melted in an induction furnace, wherein a high frequency current in an outer coil induces strong eddy currents in the platinum itself, and these currents heat the metal. The metal is placed in a crucible which must be able to stand the high temperature produced, but the rest of the furnace is fairly cool.

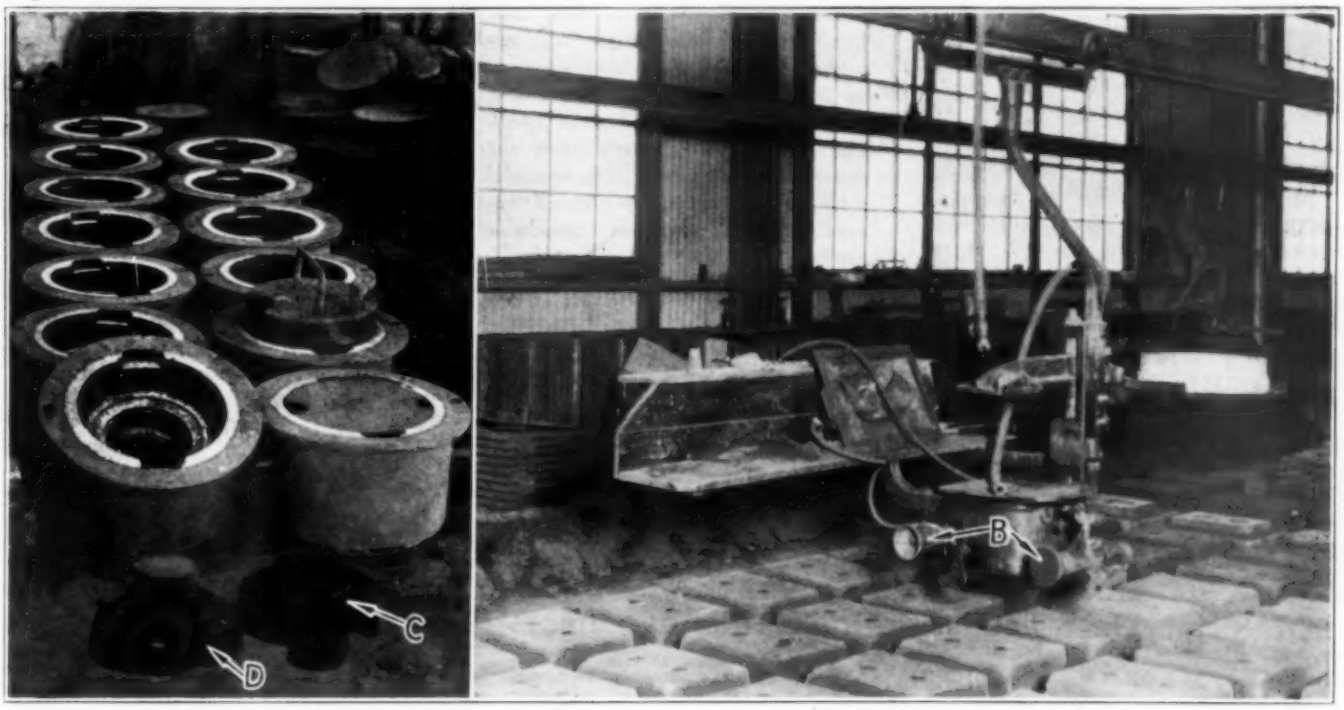


FIG. 12—MOLDS FOR AUTOMOBILE DIFFERENTIAL HOUSING CASTINGS ARE MADE WITHOUT A COPE—FIG. 13—THE LEGS OF THE MOLDING MACHINE ARE RAISED TO ALLOW IT TO PASS OVER MOLDS

The New Jersey bureau of hygiene and sanitation advises yellow brass foundries to install local exhaust hoods to remove skimming fumes. Connection can be made at the main exhaust system and dropped beside the brick or iron supports of the bays. Best results are obtained by using a 14-inch pipe widening to a 24-inch hood at a point 3 feet above the ground. An air velocity of 3000 linear feet per minute should be maintained.

Study Aluminum Hard Spots

Methods Employed To Identify Inclusions, and Determine the Effect on the Mechanical Properties, and Metallographic Structure of Oxidizing Aluminum Cast Alloys During Melting

BY A. J. LYON

HARD spots that had been the source of trouble in machining permanent mold pistons for the Curtiss D-12 airplane engines were found to be largely oxides of iron. The source of the inclusions may be the hardener used to introduce the iron into the alloy or scale from stirring rods, and melting pots.

Experiments to determine the metallographic structure of aluminum alloys containing oxides and nitrides of aluminum failed to reveal the identity of these constituents, if present, in alloys melted under conditions favorable for their formation. The effect on the mechanical properties of oxidizing the molten alloys was negligible.

Several pistons for the Curtiss D-12 engine which had been rejected on account of hard spots were used for this investigation. These pistons were cast in the following alloy: Aluminum, 88.32; copper, 10; iron, 1.25; magnesium, 0.25; impurities 0.11 per cent.

In the experiment to determine the effect of oxidizing the molten alloy, materials were used as shown in Table I.

Numerous pieces of the hard spots were isolated from the material as given in Table I and compared under metallographic and binocular microscopes with hard spots artificially produced, such as iron scale, pieces of plumbago crucible, slag, and cryolite.

To determine, if possible, the appearance of aluminum oxide and nitride in the metallographic structure of these alloys, melts were made up of approximately 25 pounds each. They first were melted according to standard practice and two test molds of specimens, air service type TB-1, were cast ½ inch diameter, 2 inches gage length, three in a mold. The metals were then placed back in the furnace and held at a temperature ranging from 1300 to 1400 degrees Fahr. A steady stream of air was passed through by a ¼-inch iron pipe, the orifice of which was placed beneath the surface of the metal. After a period of 30 minutes, two molds of test specimens, air service type TB-1, were cast on which physical tests were made, as well as those cast under normal conditions. Metallographic specimens were prepared from each melt and chemical analyses made on the melts shown in Table III.

In all cases of hard spots obtained from the Curtiss D-12 pistons the metallographic appearance was similar to samples of wrought iron scale taken from a partly melted iron-copper-aluminum hardener. Further evidence that these particles were introduced from external sources and were not an alloyed constituent was apparent, since the particles were irregular in form and were surrounded by small cavities. To further confirm their identity, several hard spots were isolated and placed on a watch glass and a drop of hydrochloric acid added. This resulted in a yellow precipitate which, upon adding potassium ferricyanide, was changed to a distinct blue, identifying them definitely as oxide of iron or at least constituents which are high in iron.

According to Roscoe and Schorlemmer, iron heated to redness in the air becomes coated with an iron scale which is a mixture of ferrous and ferric oxide. The inner layer, which is blackish gray, porous, brittle, and attracted by the magnet, has a composition FeO, Fe_2, O_3. The outer layer contains a large quantity of ferric oxide. Ordinarily, ferric oxide should only be slightly paramagnetic and is not attached by the magnet, which is further evidence that the hard spots in the pistons were iron oxides, since they were attracted by the magnet in varying degrees.

The source of this scale may have been the hardener and stirring rod, or possibly the ladle and mold. A probable source is thought to be the former.

Spots Mean Trouble

HARD spots in ferrous and nonferrous castings are a source of trouble in the machine shop. The castings are hard to machine, and damage to the tools results. Such castings frequently have to be scrapped as unworkable. This retards production and increases costs. The cause of such conditions is a subject of much discussion, and experimental work has been done in an endeavor to ascertain the cause, and if possible overcome the effect. The accompanying article gives the materials used in the experimental work, and conclusions reached regarding hard spots in aluminum castings.

Table I

Materials Used To Determine Oxidizing Effects

Alloy	Foundry Melt No.	Chemical Composition: Copper	Iron	Silicon	Nickel	Magnesium	Aluminum
Al Ingot	2690	0.07	0.07	0.04	...	....	Balance
Al-Cu-Ni-Mg ..	2582	4.03	....	....	2.0	1.52	Balance
Al-Cu-Fe-Mg ..	2853	9.85	0.84	0.20	...	0.25	Balance

Table II

Results of Tensile Tests On Oxidized Alloys of Aluminum

Alloy	Foundry Melt No.	Tensile Strength pounds per square inch: A	B	Elongation per cent in 2 inches: A	B
Aluminum-2690	2982	9,110	11,460	43.7	36.3
Al-Cu-Ni-Mg-2582	2984	27,810	29,180	1.0	1.0
Al-Cu-Fe-Mg-2853	2983	25,500	24,860	1.0	1.0
Aluminum-2690 (1)	3008	8,910	.....	33.8	....
Aluminum-2690 (2)	3009	9,850	.....	15.8	....

A=Unoxidized.
B=Oxidized.
(1)=Cryolite mechanically mixed into metal before pouring.
(2)=Cryolite introduced during melting. Maximum furnace temperature 2000 degrees Fahr.

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and for that reason the practice of making a copper-aluminum hardener by first melting the aluminum and copper together and then adding the iron in solid form and keeping it well below the surface of the molten aluminum-copper alloy and allowing it slowly to go into solution at a temperature of approximately 1800 degrees Fahr. is recommended. The usual practice is to melt the copper in contact with the iron and then add molten aluminum. The heat of reaction between the aluminum and copper is sufficient to melt the iron. Hardeners made by the latter process have been found to have considerable scale and inclusions which resemble closely those that were found in the castings under investigation.

The effect on the mechanical properties of melting aluminum and certain of its alloys under conditions that are favorable for the absorption of large amounts of the gases of the atmosphere and for formation of both nitrides and oxides may be compared with the mechanical properties of the same materials melted under normal conditions as shown in Table II. It is evident that the effect of oxygen and nitrogen on the mechanical property is of minor importance. The tensile strength was actually higher in the alloys that had been oxidized than those melted in a normal manner, which is due mostly to the increased iron content. It is interesting to observe that the castings made from this oxidized metal were actually more sound and free from pin holes than those made from metal which was melted in a normal way. It is concluded that aside from the high melting losses due to the dross that forms on the surface of the metal that the effects of the gases of the atmosphere are not as injurious as they are commonly thought to be.

The results of metallographic analyses on both the oxidized and nonoxidized material failed to show any constituent that could be identified as either nitrides or oxides of aluminum. The only difference in the structure of the oxidized and unoxidized is the occurrence of the photographs of the structure of the iron constituents. Representative micro-alloys both in normal condition and as oxidized are contained in the records of the routine alloys of this section. They are not considered to be of sufficient importance to throw any light on the occurrence of aluminum oxide and are not included. The results of the chemical analyses are shown in Table III.

Table III

Results of Chemical Analysis

Foundry No.	Melt	Chemical Composition					Remarks
	Copper	Iron	Silicon	Magnesium	Nickel	Aluminum	
2982	0.07	0.07	0.04	....	....	Balance	Unoxidized
2982	0.08	0.95	0.03	....	....	Balance	Oxidized
2984	4.03	....	....	1.52	2.0	Balance	Unoxidized
2984	4.17	....	....	1.55	2.12	Balance	Oxidized*
2984	4.05	....	....	1.58	2.02	Balance	Oxidized‡
2983	9.85	0.84	0.20	0.25	....	Balance	Unoxidized
2983	8.97	1.33	0.27	0.27	....	Balance	Oxidized†
2983	9.02	0.69	....	0.27	....	Balance	Oxidized‡

*Increase in Fe due to iron pipe used to introduce air into the molten metal.
†Sample from test specimens.
‡Sample from skimmings.

How and Why in Brass Founding

By Charles Vickers

Small Holes Found in Brass Castings

We make a considerable amount of light yellow brass castings and in order to increase the fluidity of the metal so it will run to the best advantage we have been in the habit of adding a small amount of aluminum. We find that when the surface of the castings is cut away by machine tools we find pits or holes in the metal, which we have decided are produced by the aluminum. These pits resemble dirt, but we are careful with the metal when melting and cannot believe it can be dirt. Can you suggest any other inexpensive material that can be used in place of the aluminum and produce the same effect?

There is only one other element that can be used in place of aluminum to increase the fluidity of yellow brass, and that is silicon. In appearance the castings will be the same as when aluminum is added, and the metal will run the same, but silicon can be used only when the alloy contains no lead. If the yellow metal is not leaded, use 1 per cent of silicon copper. This will cost a little more than aluminum but the cost will be saved many times over, due to elimination of dross. If the yellow brass is leaded, silicon cannot be used, because it will combine with some of the lead to form a dirty white powdery substance which will pit the surface of the castings. One trial of silicon in leaded alloys of any kind usually is enough for the average brass-founder, but used in the proper manner it is very satisfactory.

If the alloy is leaded continue with the aluminum, but use as small an amount as possible. If the present practice is to add 2 ounces per hundred of metal, use only half that amount. It is inconceivable the pits could be holes, as the aluminum will prevent holes, not cause them. The pits must be dross for aluminum causes dross unless the metal is run into the mold in such a manner that there is no agitation of the stream as it flows. Large castings of metal containing aluminum have been known to come porous, but the cause lay in the mold itself not the metal.

Seeks Cheap Aluminum Casting Metal

We are making castings of aluminum which are used as covers for automobile engines. We use the No. 12 alloy and the castings are wholly satisfactory, but too expensive as the customer sells a cheap product, and is able to use cast iron, although the latter metal leaves much to be desired, on account of weight and roughness. Nevertheless we have to compete with it, and desire to know if we could use considerable zinc in alloy with the aluminum, or is there some other alloy that could be used in place of the aluminum?

A lower cost alloy than No. 12, and one just as easy to cast, follows:

Low Cost Aluminum Alloy

	Per cent
Aluminum	82
Zinc	15
Copper	3

There is no reason for using No. 12 when this zinc-copper-aluminum alloy is available for such castings as those mentioned in the querry.

A cheaper alloy is aluminum 65 per

cent; zinc 35 per cent. But this is more difficult to cast, and there more rejections will be encountered. Therefore, it is likely it will cost more in castings than the 15 per cent zinc alloy. The latter alloy is stronger than the No. 12 alloy, and it is surprising it is not used more than the latter, especially in view of the fact it is difficult to detect that it is a zinc-aluminum alloy.

A zinc-base alloy would be still cheaper, but about as heavy as the cast iron. At normal temperatures it is as strong as the aluminum alloys, but at zero temperature it has to be handled with care, or it will break. The alloy follows: zinc, 85 per cent; copper, 10 per cent; aluminum, 5 per cent.

Casting Monel Metal

We experience difficulty in getting test bars of monel metal to meet specifications as we get only about 35,000 pounds tensile and no elongation. We sent the grip end of a broken bar to show the structure. The metal is melted in a No. 40 crucible with a cover on it and the charge consists of 60 per cent new metal with 40 per cent remelt. We have used all new metal with the same result. The castings are perfect and we have no trouble with the alloy except that we are unable to get the required strength as shown by the test bars.

The difficulty is in the manner of molding and gating the test bars which fails to permit feeding sound. We suggest the remarks on test bars in the book "Metals and Their Alloys" pages 445-449 be carefully studied and that the bars be made as illustrated on page 445, Fig. 70. This book can be obtained from the Penton Publishing Co., and will be sent on receipt of the price which is $7.50, or doubtless is available through your library.

Gas Splits Castings

We are sending for your inspection one of the radiator cap castings we are making of a yellow brass analyzing copper, 63 per cent; zinc, 35 per cent; lead, 2 per cent. The castings are made in green sand molds, and you will note that after being machined the casting split into two parts. Can you tell us the cause of this phenomenon?

The split is caused by a gaseous body produced after the metal had filled the mold and had commenced to chill where it touched the sand walls. This gas is not disseminated throughout the body of the castings forming the little holes known as porosity because it was produced outside of the metal, and not within the body of the same. In a thin casting of this nature the only space the gas can find is the liquid interior where it is held as a thin film. This gas is not oxygen, otherwise the metal surfaces would be discolored by oxidation. It is not steam because at the temperature of the metal just after pouring, and in the presence of zinc, steam would decompose. This is probably what has occurred—the steam decomposed, the zinc distilling from the alloy oxidized, and the hydrogen passing into the metal and would have made the metal porous had the latter been sufficiently liquid. Just as soon as the thin skin produced by the metal chilling against the sand is cut through, the casting separates into two parts. The cope part of the casting is rough, not from sand but from zinc oxide produced by the decomposition of the steam. Yellow brass is susceptible to this difficulty. It can be avoided by making the molds more permeable to the steam produced by the sand by using a slightly coarser grade of molding sand. If the molds are made in iron flasks with a bottom board bedded snugly against the flask, the question may be profitably asked—how is the steam to escape from the underside of the casting? If it is unable to get away through the sand it will certainly build up pressure and go through the metal, producing porous and gas-split castings. It would probably be cheaper in the end to use a yellow brass with less zinc, one that will cast better than the alloy now being used.

Seek Melting Method for Aluminum Chips

We have tried to run aluminum turnings into ingots, but have not been successful as all we get out of a pot of such turnings is dross. We have a small oil-fired crucible furnace for melting the aluminum alloys, and will appreciate any suggestion for bettering the results we have so far obtained. We have been using aluminum flux and covering the turnings with charcoal.

To melt aluminum turnings and get a good recovery of metal in a small crucible, it is advisable to start with a pool of aluminum and stir in as much turnings as the pool will dissolve without the metal solidifying. Place a clean crucible in the furnace and allow it to reach a red heat empty, then charge enough ingot to fill the crucible one-third full when it is molten. Allow this pool to attain a red color, but it must not be allowed to get more than a dull blood red. Turnings now are added until the metal begins to get thick when the furnace is closed, and the bath is brought once more to a red heat, when more turnings are charged and so on until the pot is full of metal. Then a small piece of zinc chloride is dropped on the surface stirred around, and after the fumes have passed away the pot is pulled and metal ingoted.

Never use charcoal on aluminum turnings as it burns the metal to carbide, nitride and oxide, especially when aided by the presence of certain chlorides which act catalytically. Thus zinc chloride should be used only in small amount when the melting period is over, and the metal will be pulled and poured within a few minutes. Only those chlorides having a heat of formation greatly in excess of aluminum chloride can be added safely.

Bronze Bushings

We are expected to make bronze bushings that will carry an extremely heavy load, approximately 100,000 pounds. The speed is very slow but even so ordinary bronze will not stand the load but squeezes out. Can you suggest a suitable formula?

An aluminum bronze of the following composition would carry the load stated. The alloy follows:

ALUMINUM BRONZE

	Per cent
Copper	85.50
Aluminum	11.00
Iron	3.50

This alloy has a brinell hardness as cast of 170 using the 3000 kilogram weight. It also will possess between 80,000 and 90,000 pounds tensile per square inch, with elongation of 10 per cent.

The iron is added as thin, clean sheet iron to the molten copper. It is stirred in thoroughly and the aluminum then is added. The molds must be gated at the lowest point as the metal must rise gently within the same. It also will be necessary to place on heavy feeding heads to avoid shrinkage.

Aluminum Solder

Will you kindly give us a mixture for aluminum solder? We have experienced some trouble in making such solder.

There are thousands of formulas for aluminum solders and the number is being added to continually as shown by the *Patent Office Gazette*. One alloy that finds extensive use is the following:

ALUMINUM SOLDER

	Per cent
Tin	63
Zinc	31
Aluminum	3
Five per cent phosphor tin	3

This alloy is perhaps as good as any, being known as Richards aluminum solder.

Selects Gold Medal Designs

Artists Conception of Vision, Kindliness, Achievement, and Industry Feature Characteristics of Each Donor as Portrayed in the American Foundrymen's Association Resolutions of Appreciation

ANNOUNCEMENT has been made by C. E. Hoyt, secretary, that the board of awards, chosen by the American Foundrymen's association at its Cleveland meeting in 1923, has selected four medals to exemplify the gifts made by Joseph S. Seaman, William H. McFadden, J. H. Whiting and John A. Penton. The designs of the medals were made by Frederick C. Hibbard, Chicago, a sculptor of that city.

FIG. 1—THE JOSEPH S. SEAMAN MEDAL REPRESENTS KINDLINESS

It will be noted that the obverse in each case is intended to typify an individual characteristic. The ideas embodied were suggested by the resolutions adopted by the board of directors of the association at the meeting in Cleveland in 1923. The resolution acknowledging the gift of Joseph S. Seaman indicates the manner in which the sculptor interpreted the spirit of these resolutions. The Seaman resolution said in part:

FIG. 2—THE W. H. McFADDEN MEDAL REPRESENTS ACHIEVEMENT

> This generosity to those engaged in the industry in which he was so notably successful, reminds all those who know him, of his *kindliness*. The dominant note of his character was love and cheerfulness abounding with industry. Of this spirit we sincerely hope each recipient from the J. S. Seaman fund may partake by emulating his life and character. By resolution of the board of directors, this expression is conveyed to the family of Mr. Seaman with their love for and affectionate memory of "Daddy."

From the obverse of the Seaman medal, it will be apparent how these ideas have been presented. *Kindliness* is the dominant idea typified. Similarly the McFadden medal indicates *achievement*, the Whiting medal reflects the *industry* of its donor, and the Penton medal portrays the *vision* of its giver. The reverse of each of the medals will be the same, bearing the words "American Foundrymen's Association Award of Merit" and representing two molders pouring a mold from a single shank, in the foreground and depicting a cupola, crane and crane ladle in the background. Illustrations made from photographs of the plaster casts are shown accompanying.

FIG. 3—THE REVERSE SIDE OF THE FOUR MEDALS SHOWS CRAFTSMEN POURING A MOLD

Dies for the medals are being made by the Medallic Art Co., New York. The medals will be struck from gold and will be 2½ inches in diameter.

The four contributions which these medals will commemorate were announced at the Columbus convention of the association in October, 1920. Cash gifts each totaling $5000 were offered to the association, the income to be used in making awards and giving prizes for the encouragement and stimulation of effort in the metal castings industry. The donors of the gifts were Joseph S. Seaman, third president, and William H. McFadden, tenth president of the association; J. H. Whiting, manufacturer, and John A. Penton, first secretary of the association. All of these men were charter members when the organization was founded in 1896.

FIG. 4—THE J. H. WHITING MEDAL REPRESENTS INDUSTRY

The conditions of the deeds of gift require that a board of award shall control the disposition of the principal fund, together with the income derived, subject to the terms and conditions set forth in the deeds. A board of awards was appointed, made up of the seven last living past presidents of the American Foundrymen's association with the junior past president as chairman. At a meeting of the board of awards held June 18, 1923, a committee was appointed with authority to engage an artist to make the designs and models

FIG. 5—THE JOHN A. PENTON MEDAL REPRESENTS VISION

for dies to comply with the condition of the deed of gift. At this meeting it was voted to recommend to the board of directors that the John A. Penton medal be given to Enrique Touceda in recognition of the contributions he has made to the malleable casting industry. At the same time it was decided that the J. H. Whiting medal be conferred upon John Howe Hall in recognition of his contributions to the steel casting industry. It was further recommended that if, at the 1924 convention, a paper of outstanding merit is presented, the W. H. McFadden medal shall be given to the author in recognition of such contribution, presentation to be made at the 1925 convention of the association. At a meeting of the board of directors held the following day, the recommendations of the board of awards were approved unanimously.

Frederick C. Hibbard, the designer of the medals is well known for his work on heroic size portrait statues. Among the latter is the large bronze statue of Mark Twain which was observed by many foundrymen at the 1914 convention of the American Foundrymen's association in Chicago. This stood at the cross aisle in the main exhibit arena at the International amphitheater. Other work of this nature made by the artist includes statues of Gen. James Shields, Carrollton, Mo.; Col. Alexander A. Doniphan, Richmond, Mo.; Gen. U. S. Grant, equestrian statue, Vicksburg National park; Gen. Lawton, Fort Wayne, Ind.; Dr. G. V. Black, Lincoln park, Chicago, and others. He also has made a number of soldier and general group monuments. His statue, "The Molder" won the gold medal of 1924 at the Kansas City midwestern artists' exhibition held in February, 1924.

Craftsman vs. Hero

MEUNIER, the famous Belgian sculptor swept aside precedent, and conventionalities and placed the artisan on the same level as the allegorical hero. This was a bold move, and could be satisfactorily accomplished only by a true artist—one whose genius permitted originality.

Frederick C. Hubbard, the American sculptor, fashioned the small bronze statue entitled The Molder *from a study in the Michigan Malleable Iron Co.'s plant, Detroit. The bronze figure which stands about 15 inches high has been exhibited and greatly admired by lovers of art at several of the galleries throughout the country during the past year and was awarded the gold medal of 1924 at the Kansas City midwestern artists exhibition last February. Mr. Hubbard, also had the genius to permit originality of thought at the expense of conventionalities. He had the power to fashion in bronze such thoughts as delight the eye. He exemplifies a type of craftsmanship that entitles him to a place beside the famous Belgian sculptor. This is the man chosen by the committee of the board of awards of the American Foundrymen's association to design and make the models for the dies to produce the gold medals of merit.*

Most of Mr. Hubbard's work has been on heroic portrait statues and soldier monuments for city and national parks.

Ingot Mold Castings Are Bottom Poured

Question: At present I am pouring ingot molds through an ingate at one bottom corner of the mold and am wondering if I could not secure more satisfactory castings by pouring them directly from the top. I have been given to understand that molds are poured in this manner in other plants in this country, but I cannot understand how the metal is prevented from splashing on the core at the bottom. I am using mixed numbers of hematite iron and many of the molds are disfigured by a thin shell on the corners of the core. Do you think top pouring and lower silicon iron would prevent the formation of these shells? I should like to know what kind of sand is employed for making ingot molds. How is it prepared and is it mixed with coal dust? Also I should like to know the approximate temperature at which the iron is poured and the weight of the gate in proportion to the weight of the casting.

Answer: We are not familiar with the practice in the two plants to which you refer, but so far as we know the universal practice in the United States is to pour the molds from the bottom. Stories covering the practice in three typical plants appeared in THE FOUNDRY on Sept. 1, 1919, March 15, 1922 and Feb. 15, 1924. We shall take up your points in the order which you present them.

The objection to top pouring is that on account of the tapered core the metal cannot fall vertically to the bottom. It will impinge on the face of the core and probably cut it. We can imagine that if the metal should be introduced through a considerable number of small runners on the top the result would be satisfactory, but that method of gating involves considerably more work than the familiar down gate, so why change?

Hematite iron with a silicon content between 1.75 and 2.00 per cent makes satisfactory molds. The composition of the iron has no bearing on the scabs on the inside corners of the mold. They are due to a condition of the sand. Probably you have no vents in the corners of the arbor. Again, it is possible that the rammer was employed too strenuously and too close to the face of the corebox. Hard flakes of sand formed in this manner invariably will fall off when surrounded by molten iron.

A strong, open sand is employed for making ingot molds. That is a sand with a coarse grain and with a natural bond. Sand deposits vary in different parts of the world and, therefore, no rigid rule can be laid down to cover the proper mixture. The facilities for mixing the sand also constitute a factor. For example where a muller type of mixer is available the amount of new sand may be cut down materially. In one foundry with which we are familiar the sand is mixed by hand. The cores are made from new sand exclusively and the sand for the jackets is mixed in the proportion of one part new sand to three parts old sand. No coal dust is mixed with the sand.

We never have heard that the pouring temperature of the iron has any bearing on the condition of the molds. Usually the iron is poured at a temperature that will insure it running freely, approximately 2200 degrees Fahr. However, where direct metal is employed and where a large ladle serves to pour a number of molds, it is apparent that the last mold will be poured at a considerably lower temperature than the first one. The colder the iron is poured, consistent with safety, the smoother will be the resulting skin on the casting. Theoretically the weight of the gates could be designed in proportion to the weight of the casting, but in actual practice you will find that, for example, a 2½-inch diameter gate will be employed to pour castings ranging from 2000 to 4000 pounds.

Ernst & Ernst, auditing firm and experts on tax service with offices in the larger cities have published a booklet on the responsibility of bank directors. This calls attention to the duties of the directors who usually are not bankers, but are executives prominent in manufacturing or other activities.

Nine Tons in a 3-Ton Furnace

Capacity of Electric Furnace Increased To Melt Sufficient Iron To Pour Large Gear Wheel—Operating Door Banked Up About 10 Inches with Cement Made of White Sand and Sodium Silicate

BY LARRY J. BARTON

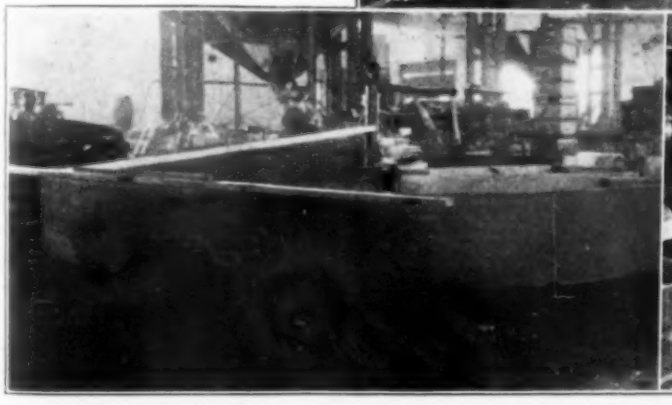
IN MAKING large castings it sometimes happens that more metal is needed than can be produced by the melting unit operating at its rated capacity. In such cases it may be possible to make sufficient minor changes in the design of the melting unit successfully to melt a larger tonnage of metal. This operation recently was illustrated at the plant of the Dibert, Bancroft & Ross Co., Ltd., New Orleans, when, in producing a large gear wheel, 9 tons of metal was melted in a 3-ton electric furnace.

With no possible chance of digging out the hearth, considerable thought was required to devise a method for supporting the large body of metal and at the same time, to allow the furnace operations to be handled satisfactorily. Other questions called for a solution, such as obtaining hot steel at the bottom of the melt, being able to tap out successfully, to manipulate the slag, and most important to keep the metal within the desired analysis.

A general idea of the casting may be gained in Figs. 1, 2 and 3. The method followed in molding the gear wheel is shown in Fig. 2. A gear sugment mounted on a spindle was used and the teeth were swept up. Fig. 3 shows the molded wheel after the rim had been washed with silica flour and dried with charcoal pots. The manner in which the *dogs* were placed at each pad to prevent cracking during shrinkage is shown. Two gates were used. In the right foreground are piled the additional cores to make the inner face of the gear wheel. After the cores had been set, a row of cores was placed around the rim to form the cope, the cope being weighted heavily. Fig. 1 shows the method of securing the mold, with the first set of weights in place.

The furnace used was a standard 3-ton type manufactured by the Pittsburgh Electric Furnace Corp., Pittsburgh, and operated on an acid hearth. The furnace hearth was such that a 7000-pound charge, when melted, was even with the door sills. The furnace was charged as shown on the charge sheet, Fig. 10, the large pieces being placed on the hearth and the cavities filled with punchings. Similar layers were added until the furnace was charged. A heavy steel plate was placed inside the furnace to prevent the charge from sliding onto the sills until melting had been started. The rear, or operating door, was banked up about 10 inches with a cement made of white sand and sodium silicate. The cement was placed on to a thickness of about 12 inches. A ½-inch plate was slipped in behind the door jamb castings on the furnace to support the weight of the metal pushing against the 10-inch dike of sand. The pouring spout was built in a different manner as it was necessary to be sufficiently low to pour and yet hold the bath of steel. A 3-inch dike of the rammed mixture was placed across the pouring spout and was supported from behind with clay bricks. The clay bricks in turn were supported by about 10 inches of rammed sand and cement. This was placed in position the night before to assure a perfect set.

The log of the heat, shown in Table I. indicates the progress of the heat. Fig. 4 shows the furnace tests as taken during the melt, their order being from left to right, the lower row first. Fig. 7 show the exterior of the furnace and Fig. 6 shows the furnace pouring into the ladle. A view of the gear wheel during the cleaning operations is shown in Fig. 5. This view also shows the method of placing the heads. A view of the wheel being machined on a 16-foot boring mill is shown in Fig. 8, while Fig. 9 shows the wheel attached to the spider and ready to ship. The wheel and the spider weighed 25,000 pounds, the spider being of cast iron. The wheel itself weighed 13,300 pounds. The diameter of the wheel was 13 feet 8 inches while the face was 18 inches. The thickness of the section was in proportion. After the



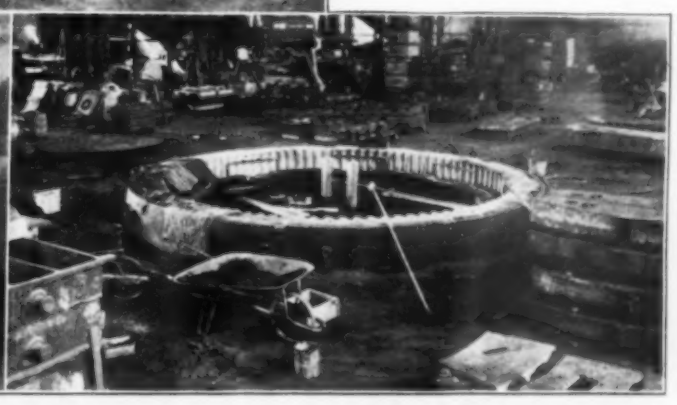
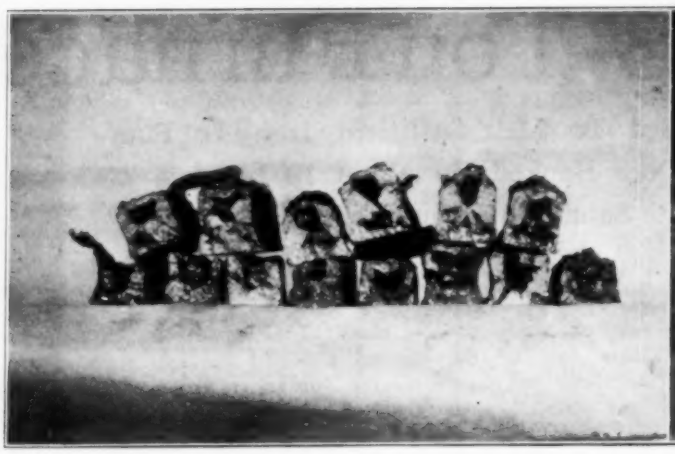


FIG. 1—ABOVE—METHOD OF SECURING MOLD WITH FIRST SET OF WEIGHTS IN PLACE—FIG. 2—LEFT—A GEAR SEGMENT MOUNTED ON A SPINDLE WAS USED—FIG. 3—RIGHT—ADDITIONAL CORES WERE USED TO MAKE THE INNER FACE



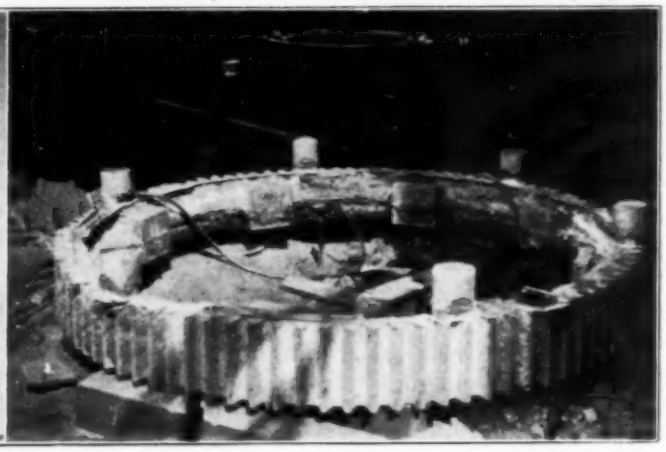
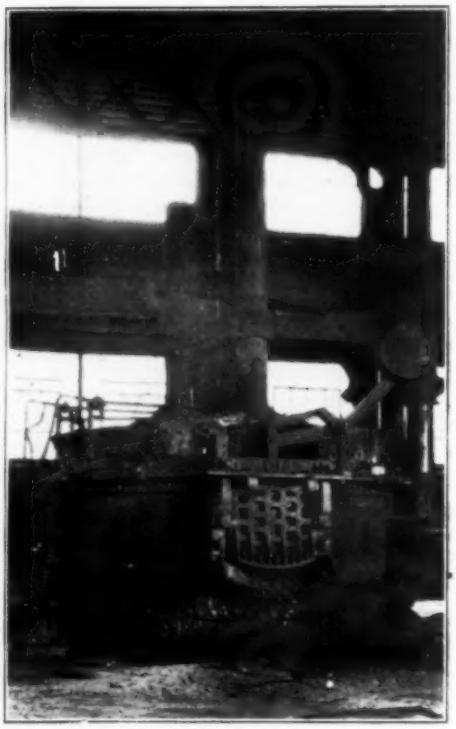
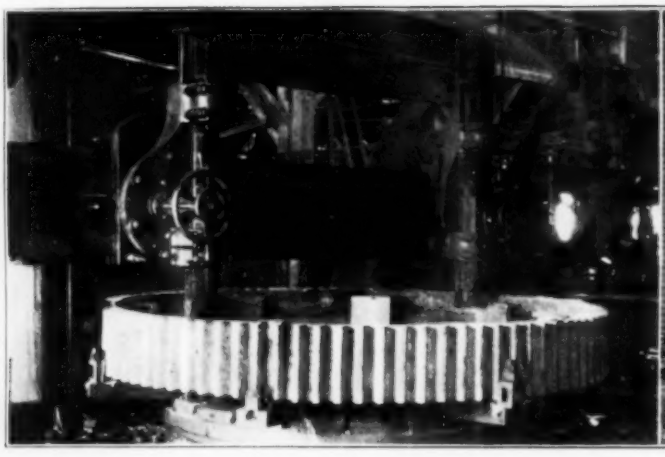


Fig. 4—Upper Left—Numerous Tests Were Made During the Melt—Fig. 5—Upper Right—View of the Gear Wheel Partly Cleaned—Fig. 6—Left—The Electric Furnace Pouring Metal Into-the Ladle—Fig. 7—Right—A View of the Electric Furnace Used—Fig. 8—Lower Left—Machining the Wheel on a 16-Foot Radial Boring Mill—Fig. 9—Lower Right—The Wheel and Spider Weighed 2500 Pounds





casting was poured, considerable manipulation was required to dig out the center sand so that the shrinkage would be taken up with no chance of cracking. The total shrinkage was a little over 3 inches, and when the wheel had cooled no cracks could be found. The gear wheel was ½ inch out of round, requiring but little forcing to fit the spider. Exactly 8 days were required from the time the order was received until the finished casting left the shop. The wheel was propped in a steel gondola hauled to the river and conveyed to Cuba by boat. A heat of this size represents about the absolute capacity for a 3-ton furnace, due to the difficulty of heating the lower sections of the bath burning the roof or the walls.

Electric Furnace Heat Sheet

Heat No. 476 Date 2/1/24

Heats from roof 169 Lining 476 Bottom 476

Condition of roof ____ Lining ____ Bottom ____

Specification C ____ Mn ____ Si ____ P ____ S ____

Heat Made C ____ Mn ____ Si ____ P ____ S ____

CHARGE	WEIGHT	SLAG MATERIAL	WEIGHT
Pig Iron		Lime	
Scrap Cast		Lime Stone	
Steel Scrap Bolts	7500	Shells	
Steel Scrap Punchings	3000	Fluorspar	
Plate Scrap	2500	Sand	
Shop Scrap	4000	Ground Coke	
Ferro Manganese	170	Magnesite	
Ferro Silicon	68	O H Slag	
		Electrodes	
		Ore	
Total	17238	Total	

Current on 7 00 AM Current off 10:35 Total Time 3:35 Time Ton ____

Meter after 1085500 Meter before 1081000 Total KWH 4500 KWH Ton 522

Delays and Causes ____

A TOTAL OF 17,238 POUNDS OF SCRAP WAS CHARGED

Fine Sands Will Cause Scabby Castings

Question: Many of our small and medium size castings present a scabby surface and we find it necessary to nail all corners and edges in our molds. Will you kindly supply us with the name of the best sand to use for making light and medium weight castings. Do you know of any book that would assist me in figuring prices on jobbing castings.

Answer: From the information submitted we naturally should infer that without your trouble is due to one of two probable causes. Your sand either is too close or you are ramming it too hard. If you are satisfied it is too fine the remedy is to discontinue its use and substitute a coarser grade. The sand dealer from whom you secure your supplies of new sand, usually is in a position to furnish any grade desired. Also, as a general rule, he can give valuable advice on how each grade should be handled.

Before making a change, it might be well to check up on your molding practice. Excellent sand sometimes is condemned through lack of knowledge on the part of the molder. Men accustomed to coarse sand and heavy ramming probably will ram fine sand in the same manner. Steam will escape freely through coarse sand even if it rammed fairly hard, but fine sand when rammed hard will block the exit of the steam and scab off the face of the mold. Instruct your men to ram all corners, pockets, etc., quite soft, use the vent wire freely and if that does not prevent the sand from scabbing it is apparent that a coarser grade is required. *Foundry Cost Accounting*, by Robert E. Belt, while primarily written as a guide for installing a cost account system in a foundry, contains all the information necessary to estimate casting contract prices. It is published by the Penton Publishing Co., Cleveland, and may be ordered direct or through THE FOUNDRY. The price is $5.00 net. We should suggest that you join the local foundrymen's club in your city which meets every month to discuss problems connected with the industry. It is a great institution for exchanging information.

Charles Longenecker, formerly sales engineer with the Bonnot Co., Canton, O. has become associated with the Combustion Engineering Corp., 43 Broad street, New York. Mr. Longenecker will be connected with the recently created industrial department of the Combustion Engineering Corp., which is specializing in the application of pulverized fuel to industrial work.

Log of Heat Where Large Charge Was Melted

Charge 17,000 pounds of clean, selected scrap, the higher carbon metal being charged on the hearth so that the rising carbon could be taken as an indication as to how melting was progressing in the lower layers of the charge.

7:00 a. m.—Current on at high voltage.

8:40 a. m.—Good sized pool in center of furnace. The metal has melted from the top, leaving a ring around the walls about 1 foot thick, with raw scrap over 2 feet deep underneath the bath. Metal test taken shows a very low carbon as was expected. Estimated at about 0.04 per cent carbon.

8:45 a. m.—The long arc offers too much radiation, the walls and roof beginning to drip. Changed current over on to the low transformer tap.

8:50 a. m.—Slag very thin, but a fair green. Added five shovels of old molding sand. Metal test shows carbon picking up as pool digs deeper.

8:55 a. m.—Slag excellent, thin and foaming. Metal gaining in carbon, and becoming more solid.

9:05 a. m.—Metal coming up better.

9:15 a. m.—Carbon increasing; metal more solid, with a better crystalline structure.

9:25 a. m.—Fine metal test. The heat has penetrated to the lower layers and the bottom scull is just beginning to melt. Conditions heavily reducing, with a perfect green yellow slag.

From this point to 10:05 conditions about the same, with but a very light scull in the test spoon at the latter time.

10:10 a. m.—Metal pours clean from the test spoon. All conditions within furnace perfect. Metal estimated at 0.28 per cent carbon. Silicon beginning to reduce slightly.

Tests taken every five minutes to 10:25 a. m. show constant carbon; silicon picking up slowly, but regularly as can be seen by the oxygen blows. Silicon estimated at from 0.15 to 0.20 per cent.

10:30 a. m.—Perfect conditions; metal fairly cold, but considered hot enough to tap. Changed furnace over to high voltage, and added manganese, the ferroalloy being added in good sized lumps and well moistened. The slag is now a perfect color, and texture, but is thickening rather fast. Started to dig out the dike around the spout. This was accomplished by first digging away the outer layers of the cemented sand, and exposing the bricked wall. The center brick was removed with a hooked bar, then the side bricks until all that was left to hold the metal was a 4-inch dike of the cemented sand. The current was shut off and the electrodes raised. A sharp pointed bar was used to break through this dike, in a similar manner to tapping an open-hearth furnace or a cupola. As soon as the metal began to flow a heavy bar was rammed into the wall and the steel poured out. As soon as the first rush of the flow had spent itself the furnace was tipped in the regular manner.

10:35 a. m.—Furnace emptied. The metal when poured was extremely hot on the upper furnace layers, and rather cold underneath, but so mixed in the ladle that a temperature of the required point was attained.

The metal was poured from a bottom pour ladle equipped with a 2½-inch nozzle. The steel poured perfectly and laid absolutely smooth in the mold. Approximately 200 pounds of scull was left in the ladle after the pour.

A heat of this size represents about absolute capacity for a 3-ton furnace due to the difficulty in heating the lower sections of the bath, without burning down the roof and walls. In this particular instance the walls were of silica brick, while the roof was of first quality clay shapes.

Bill Airs Views on Sashweight Castings--V

RECENTLY I had occasion to travel by rail from one town to another. Usually when I am obliged to leave the old fireside for a trip out of town I arrange to take a sleeper. I creep into a berth before the train starts and sleep peacefully until I arrive at my destination. Circumstances interfered on this particular occasion. I was forced to travel by daylight. To ease the monotony I made a small deal with the cheerful young peanut hawker by which I came into possession of a copy of the current issue of one of our popular magazines.

I settled back in the seat with a sigh of content and proceeded to wade through page after page of advertisements extolling the merits of private schools for young ladies and gentlemen. From a purely impersonal viewpoint I was moved to wonder whether the students in these schools had any more fun, acquired any more knowledge or achieved any greater measure of success in after life than the less fortunate thousands who have to be content with the ordinary public school course.

Finally I emerged from the magnificent grounds and salubrious environments common to all these educational establishments and arrived at the first page of what is known among the profession as pure reading matter. Here I discovered an interesting article on the subject of pet aversions. I read it all the way through confidently expecting to find mine, if not at the head of the procession, at least receiving honorable mention. To my astonishment it was not even listed. I felt slighted and made a mental vow to buy no more magazines. Reluctantly I was forced to the conclusion that the author either was grossly incompetent to treat the subject properly, or that he actually was in league with the greatest pest that ever set pen to paper, that melancholy specimen of humanity, male or female who writes blank verse. Possibly my big feet, metaphorically speaking, have prevented me from soaring to the ethereal heights where one is enabled to comprehend and enjoy these effusions, but up to the present I gnash my mental teeth whenever I see one of these dreary compositions disfiguring a fair white page.

When I read poetry I want something with a swing and a go to it; something set to a definite measure over which my mind instintively can beat time. Something in which the words at the end of the lines rhyme in regular order. I want poetry with a definite theme, where the poet has something to say and has the ability to say it in graceful and suitable language. I can extract a certain amount of pleasure from the perusal of some prose compositions, but not in the same degree as the exquisite pleasure I derive from the liquid, flowing melody of poetry. At the moment I have in mind particularly Kipling's poem *The Grave of the Hundred Head*. You know the one that begins and ends with the same verse:

There's a widow in sleepy Chester
Who weeps for her only son;
There's a grave by the Pabeng river,
A grave that the Burmans shun,
And there's Subadar Prag Tewarri
Who tells how the work was done.

I trust I am no more bloodthirsty than the average citizen, but I must confess that I experience a feeling of perfect contentment each time I read the story of how these native soldiers avenged the treacherous murder of their young British officer in the depths of a Burman jungle. They laid him in a narrow grave in a foreign land far from home and kindred and they wept—these men of an alien race. Then they swore a great oath by all they held sacred in this world and the next that the soul of their departed leader should go to his God in state, with fifty file of Burmans to open Heaven's gate. They may have been heathens, but they were no pikers.

The command of the little party of 20 developed on that doughty little fighting man Subadar Prag Tewarri and his trusty ranking assistant Hira Lal and the whole hearted and satisfactory manner in which they discharged their humble vow commands my unstinted admiration. They may have had funny names but they certainly were highly skilled workmen in their chosen calling. They fell on the terrified murderer's village like a magnified wildcat, if one can imagine a screeching wildcat equipped with a deadly rifle in one hand and a wicked Malay kriss in the other and when they were through they had a collection of gory heads—five score heads and twain. Undoubtedly the twain were taken to offset any possible discount when the official count was held later. Subadar

ONE POET KNOWS WHAT TO DO WITH HIS STUFF

Prag had set the figure at five score and his men would not see him disappointed for the sake of a head or two.

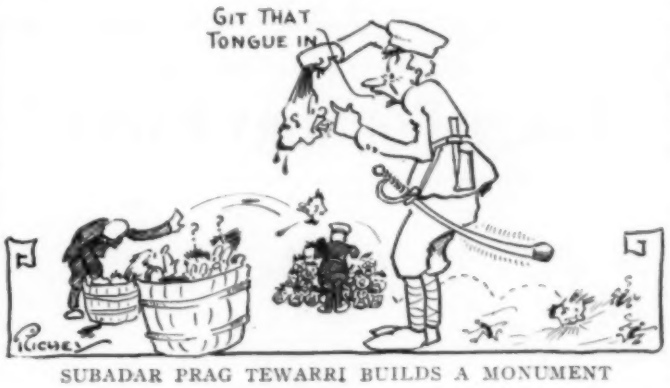
They packed the heads in baskets and retraced their steps to the grave "and the drip-drip-drip from the baskets reddened the grass by the way." They erected the heads in a pyramid over the grave with the head of the Boh on the top and the head of his son below. They added the sword and the peacock banner by way of a finishing touch and then considered their work was done. No violent effort of the imagination is required to believe that in that particular section of the White Queen's far flung dominions the rifles squibbed no more when the natives realized that the life of a single white man must be paid for with lives five score.

There's a widow in sleepy Chester,
Who weeps for her only son;
There's a grave by the Pabeng river,
A grave that the Burmans shun,
And—there's Subadar Prag Tewarri
Who tells how the work was done.
Good old Prag!

I directed Bill's attention to this poem on a recent occasion. He admitted that the theme was of an appealing character. Also, he admitted that the bird with the funny name was a man after his own heart, but he claimed the story might have been told to better advantage in prose.

"This here poetry stuff," he said, "is a good deal like a barber's cat, all wind and piffle. Give me the good old prose where a man can say what he wants to say without having to twist his words around so that they may rhyme with one another. I'd be in a fine pickle, now wouldn't I if I had to write a poem describing the manufacture of sashweight castings? I have one or two further observations to make on that subject and by your leave I will stick to the style of language with which I am familiar.

"Sashweight castings may be adapted to molding vertically in green sand where certain fundamental principles are kept in view and where the equipment conforms to local condition. The lateral pressure on the sides when the molds are filled with iron is much greater at the bottom than it is at the top. For this reason it is apparent that the sand in the lower part of the mold must be rammed harder than the sand in the upper part of the same mold. Even experienced molders at times overlook this feature and that is the reason why the method frequently is abandoned after a short trial with green or semiskilled help. The sand must be rammed uniformly and with a gradually increasing density from the rollover board to the bottom board. Where no bottom board is employed and where the drag is *not* rolled over, the density of the sand decreases with each successive ramming from the bottom of the patterns to the top.



SUBADAR PRAG TEWARRI BUILDS A MONUMENT

"For economic reasons the patterns are arranged in the flask with a minimum dividing wall of sand between them. This comparatively light body of sand constitutes a double hazard in the hands of any person except a skilled molder. Not necessarily a skilled molder in the generally accepted sense of the term which implies one who has spent many years at the trade and has become highly proficient in one or more branches. In this particular instance the term skilled molder means a man who has had sufficient experience on this particular job to become acquainted with all the dangerous features. Also, one who has developed a sufficient degree of skill and dexterity to pack the sand in a manner that will neutralize practically all these dangerous features.

"One of the anomalies of the sashweight business, especially when carried on as a side line, is that the castings rarely are made in a foundry devoted to heavy castings where the sand is coarse and open. Usually they are made in a shop where the sand is only suitable for making light castings. Coarse open sand may be rammed hard without affecting the behavior of the iron, whereas if the sand usually employed for making light castings is rammed hard, the molten iron will not lie quietly against it. The iron will *boil* in the mold and the resulting casting will contain blowholes. The violent commotion will disturb some of the sand forming the surface of the mold and the castings will present a scabby appearance. As a result of the high percentage of bonding element in sand for light castings, the refractory element is comparatively low and, therefore, the iron in the sashweight castings will fuse to the surface and present an extremely difficult cleaning problem.

"Where these conditions are encountered the logical remedy is to discard the sand for these castings and provide a supply of suitable open grain highly refractory sand. Remedial measures may be applied to a certain extent if no suitable sand is available. The sand should be worked in a comparatively dry condition, the vent wire should be employed freely to form vertical passages for the escape of gas and steam between the individual castings and, most important of all, the density of the sand must be gaged to a nicety under the rammer.

"However, all these features presuppose a skilled knowledge on the part of the workman and since these castings usually are made by unskilled help, the foundry manager finds that it is easier to supply suitable sand than it is to attempt to train men in the use of sand that requires such tender manipulation.

"The advent of the molding machine and its almost universal adoption has been the greatest single factor in directing foundrymen's attention to the importance of selecting a suitable grade of sand for various classes of castings. The ideal mold is one from which as many hazardous features as possible have been extracted. Many times I have wondered why foundrymen persist in us-

WHAT HAVE WE HERE? 'TWAS A BALMY SUMMER EVENING AND A GOODLY CROWD WAS THERE!

ing sand that requires excessive artificial venting. So long as skilled molders were available, men who could adapt themselves with slight practice to the use of any sand, this feature was not particularly serious, although it involved considerable wasted time.

"With the extensive adoption of the molding machine and the introduction into the industry of a large number of operators without any previous training, the question of simplifying the process of making a mold became paramount. Several features that formerly demanded the highest degree of manual skill and dexterity now are cared for mechanically with greater speed and precision than ever were attained under former conditions. Among these may be mentioned preparation of the sand, ramming the sand and drawing the pattern. I have no desire to belittle the faithful old vent wire. It has its legitimate place and must be used on occasion, but there is no excuse for its indiscriminate use where a slight change in the quality of the sand would render its use totally unnecessary. With the proper kind of sand, intricate castings like automobile cylinder blocks are made in green sand molds by men who never saw a vent wire. In certain old fashioned jobbing foundries if the molder does not jab a vent wire all over the cope and drag of the most ordinary flatback, the casting will be scabbed on the face." "Come back," I said. "In the words of Kipling's famous old ballad 'Come you back you British soldier, come you back to Mandalay.' You start talking about sashweights and wander off among cylinder blocks and flatbacks. If you have anything about sashweights on your mind, shoot. Otherwise put away the bow and arrows until the wind sits in a more favorable quarter my dear young archer."

"Sometimes," said Bill, "you make me think you haven't all your marbles. The various operations in a foundry hinge to such an extent upon one another that a description of one inevitably involves the others. I was leading up to a description of the manner in which sashweights are molded vertically on a jolt machine and since the success of the method depends primarily on the quality of the sand, naturally that feature merited some consideration. The most elaborate and perfect mechanical equipment will not produce satisfactory castings unless a suitable grade of sand is employed for forming the molds.

"The pattern equipment may be adapted to a plain jolt machine, a rollover stripping plate jolt machine, a pattern-draw, jolt machine, or a rollover, pattern-draw, jolt machine.

"The only function of the plain jolt machine is to ram the sand. The flask is lifted off and rolled over by a small hoist and the patterns are drawn by hand. Long guide pins are provided on the flask to insure a fairly straight and accurate draw. If the flasks are placed on a conveyor, bottom plates or boards will be required, but if the flasks are placed on the floor to be poured, these pieces of equipment will not be necessary. The patterns are formed from sections of steel pipe and may be attached to the pattern plate according to any one of several methods. Probably the most convenient is to thread one end of the pipe and screw it into a tapped opening in the plate. The opposite end of the pipe is tapped and plugged. The patterns are mounted about 2 inches apart in staggered rows to minimize the danger of the metal bursting from one mold into another. The castings are poured from the top and the gates are arranged in a manner that will insure an even distribution of the iron. It readily is apparent that if this precaution is neglected and if some of the molds fill before the others, the pressure on the full molds will have a tendency to crush the walls of the adjoining empty molds.

"On the rollover, stripping-plate machine, the mold first is jolted, then raised on the stripping plate to a height where it will clear the tops of the patterns. It then is rolled over and placed on the floor. In another type of machine, the stripping plate remains stationary and the patterns are pulled down through it by suitable mechanism. On the pattern-draw, jolt machine the drag first is jolted and then rolled over. In one type of machine the inverted flask is held above the machine. The table is elevated a second time until it engages the under surface of the battens on the bottom plate. The clamps then are released and the drag descends leaving the pattern in its elevated position. In a second type machine, the flask is rolled over and deposited on a suitable stand provided with equalizing equipment that insures a level pattern. The clamps are released and the same piece of equipment that rolled the flask over now is given a perpendicular motion for a suffcient distance to draw the pattern. I should like to say a few additional words about the gates and the copes but that opens up a rather wide field for discussion."

"Whatever else they say about you Bill," I said, "no person ever can truthfully claim that you were sparing on the words. Just for contrast I should like to introduce you some day to the genius in the Pennsylvania town who found that his door bell no longer was in working order. He was no windjammer suffering from a desire to write a three line sign where one would do. He explained the accident, directed attention to the condition of the mechanism and issued the necessary directions to any prospective visitor in just four words one more than Ceasar used in his famous message 'Button don't bell. Bump!' "

FAKED FOUNDRY FACTS

A HANGING POCKET

Special Flask Equipment for Bath Molds

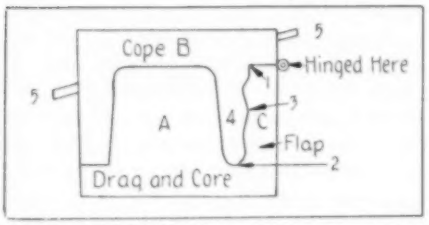
Question: We are interested in the manufacture of bath tubs and will appreciate any information you can give us on the methods by which these castings are made in United States foundries. We are familiar with the methods pursued in the manufacture of the ordinary bath tub with a roll rim and four feet. The information we require is in connection with the tub known in this country as a curtain bath. An outside wall extends to the floor. Where the tub is designed to fit closely against the wall of the room, the supplementary apron only appears on the front and one end. Where the tub is designed to occupy a clear space on the floor, the apron embraces both sides and both ends presenting the appearance of a solid block resting on the floor.

Answer: The tub to which you refer is known in America as an apron tub or a built-in tub. A description of the best and most modern method of molding these tubs would entail the preparation of a great many drawings. However, since you are familiar with the methods of producing ordinary bath tubs we assume that a brief description together with the accompanying sketch will convey the idea in a sufficiently satisfactory manner.

The sketch is a cross section through a completed mold. The apron 3 is shown somewhat exaggerated and for one method the curves must be designed in a manner that will permit the cope *B* to be closed down over the drag *A*. The drag is rammed on a suitable pattern or corebox as it sometimes is designated. After the drag is rolled over the pattern is drawn, the cope is rammed on another suitable pattern equipped with the loose apron plate 3. The loose flap *C* is bolted and hinged to the cope. The space between the flap and the apron is rammed and a parting is slicked at the line 1. The remainder of the cope is rammed in the usual manner and then the cope with the apron pattern is lifted and rolled over. The flap *C* is turned back to release the apron plate 3 which then is removed and the flap returned to place and bolted. The combined cope and flap then is rolled back to its original position and closed down over the drag. The mold is poured through a number of pop gates on the highest part of the mold.

The foregoing represents one of the standard methods employed in a comparatively small number of foundries engaged in the production of these castings. Many foundries specialize in sanitary ware castings, but few handle built-in bath tubs.

In a second method a two-part flask



CROSS SECTIONAL VIEW OF COMPLETED MOLD WITH FLASK CONSTRUCTION AND PARTING LINES INDICATED

is employed where the flap *C* becomes a side for the drag. The joint marked 2 in the sketch is eliminated and the cope joint on the high side is made at 1. This method is comparatively simple with the exception that extreme precaution must be observed to prevent adjacent vertical surfaces 4 and *C* from touching while the mold is being closed. The curves on the pattern must be laid out in a manner that will provide clearance between the two sand walls while the cope and drag are tipped at the proper angle to facilitate closing.

The drag is tipped at the desired angle on a special fixture provided with four uprights on which the cope is laid. The uprights and cope are lowered by a hydraulic plunger. The angle of the cope is controlled by the plugs 5, 5 which rest on the upright pins. Regular flask pins on the joint, guide the cope into place.

The corner tub with an apron on one side and one end is made according to the first method by providing a flap on one side and one end of the flask. They swing on hinges as previously described. When made in a two-part flask it is made on the same principle and closed in the same manner as the mold for the recess tub. It is closed in the same manner with one exception. The drag and cope are adjusted accurately on the closing fixture and tipped at a previously determined compound angle. The lugs are cast on both sides of the cope and planed at a compound angle. However, after the flasks have been prepared properly, the actual operation is simplified and is within the capacity of handy men. A special bar is provided for carrying the body of sand 4 between the apron and the wall of the tub.

Orders received by the General Electric Co., Schenectady, N. Y., for the year ending Dec. 31, 1923, amounted to $304,199,746, compared with a total of $242,739,527 for 1922, or a gain of 25 per cent according to a recent announcement by Gerard Swope, president of the company. For the fourth quarter of 1923, orders totaled $74,452,442, as compared with a total of $66,568,333 for the corresponding quarter of 1922, or a gain of 12 per cent.

Issue Government Gray Iron Specifications

The United States government master specifications for gray iron castings have been issued as specification No. 141 officially adopted by the federal specifications board on May 1, 1924, for the use of the departments and independent establishments of the government. These are the same as adopted by the American Society for Testing Materials in 1905 and revised in 1918 with a few exceptions. The government elaborates on the packing and marking of castings as follows:

A. Large castings shall be stamped with the melt or lot number and where practicable, with the pattern number.

B. Small castings shall be properly separated by melts or lots when presented for inspection and when shipped, and shall be so marked that their identity will be clear at the point of delivery.

C. A lot shall consist of castings poured from the same melt, unless otherwise mutually agreed upon by the contractor and the inspector.

D. If special packing be necessary to secure the acceptance of castings by common or other carriers for safe transportation at the lowest rate to the point of delivery, such packing shall be provided by the contractor without additional expense to the purchaser.

The specifications state further that all patterns furnished by the purchaser shall be properly cared for, and when being returned to the purchaser shall be suitably boxed or crated by the contractor to prevent damage or breakage. Before shipment from the foundry patterns shall be inspected by the representative of the purchaser, and report made by him if found to be in unsatisfactory condition.

The government tension test specimen requires slight modification in the design as given by the American Society for Testing Materials test bar, in that the center diameter of 0.80 inch, 1 inch length, is changed to 0.80 inch diameter over 0.25 inch in length. This smaller section tapers toward the neck, a distance of 0.375 inch. The neck forms a right angle with the threaded section which is 1¼ inches in diameter. No fillet is shown between the neck and the threaded end.

Steel Wheels Distorted on the Cope Side

Question: Recently we cast some 5-foot steel gears and after they were cleaned we found that the diameter across the cope face was 3/16 to ¼ inch greater than across the drag face. The pattern was drafted possibly half this amount. After the metal sets in the heads we tip the molds and remove the sand from between the arms to

facilitate contraction and we are wondering if this practice is responsible for the trouble. We have noted the same peculiar feature, although to a less degree when casting smaller wheels 30 inches diameter.

Answer: In all probability the trouble is due to the manner in which your molders rap the patterns while withdrawing them from the sand. Measure some of your other castings and you probably will find them distorted in a similar manner. Because the distortion does not affect their usefulness your attention may not have been directed to them in the past. Many molders in steel foundries received their early training in gray iron foundries where the green sand must not be rammed too hard. When they enter a steel foundry and are instructed to ram the sand hard in the dry sand molds their early training teaches them that the pattern must be rapped severely before it can be drawn out of the sand. In the case of a gear wheel one of these men first will rap the hub, arms and all around the rim with a sledge hammer. Then he will insert the draw screws and with two men helping him, will rap horizontally and continuously on the interior of the rim until the pattern is clear of the sand. With a proper pattern all this rapping is unnecessary. Patterns on molding machines are not rapped and yet they leave the sand readily. In some cases it is necessary to attach a vibrator to the plate or the pattern, but the patterns are not struck violently with either a small or a large hammer. Where the sand is rammed by hand and the wheel is made in the usual manner practiced in a jobbing foundry, a little rapping is required, but it must be done intelligently to prevent distortion. With a block of wood in one hand and a sledge hammer in the other the molder raps the arms and the inside of the rim along the center line. Whatever loosening is done in this manner applies to the whole pattern and is not confined to the top. Three men are required to draw a 5-foot gear wheel pattern out of the sand. The pattern is provided with six arms and the men insert the draw screws in alternate arms. Each man lifts on a screw with one hand and raps down gently, but rapidly on *top* of the rim with a hammer held in the other hand. This top rapping supplies sufficient vibration to loosen the pattern, but does not distort the vertical face of the mold. It is unnecessary to add that the three men must lift at a uniform speed to maintain the pattern perfectly level when leaving the sand.

Reducing Excess Noise in the Foundry

BY T. C. ROANTREE

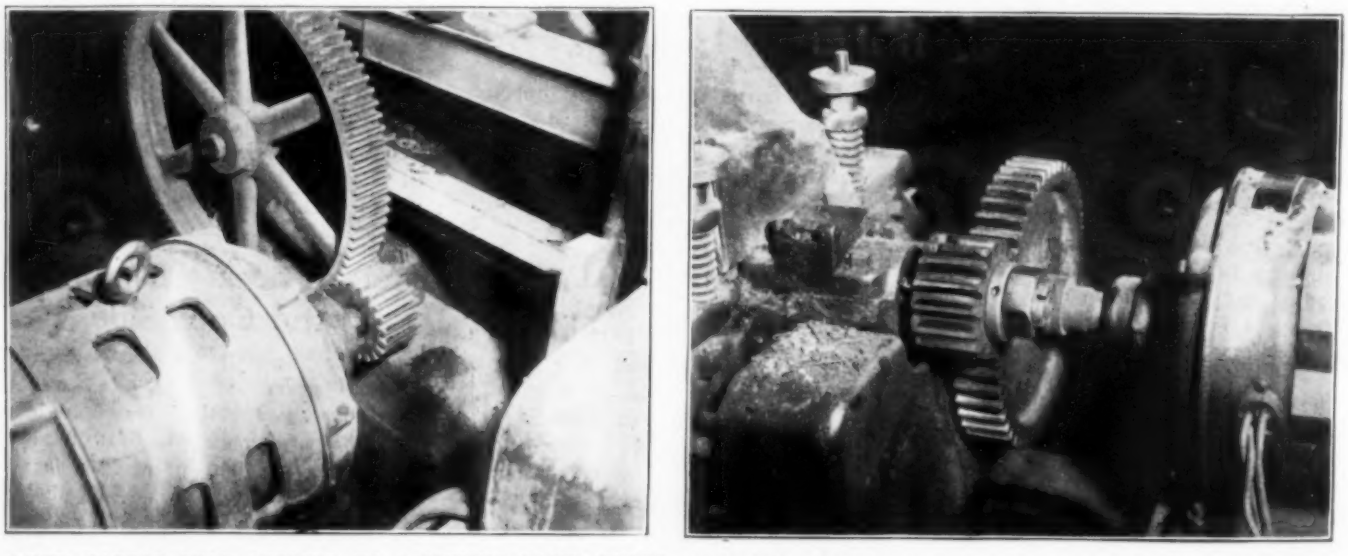
THE advisability of reducing noise in all factory operations is well known and acknowledged generally today. The management that constantly is looking for ways to better the working conditions of its employes has realized the advantages of reducing all noise as much as possible. However, many foundry superintendents fail to appreciate the extent to which a silent gear material may be used in various departments.

Several companies now are producing fabric gear material, all similar in appearance. A variety of substances are used as a bond between the layers of fabric, and which, together with the different processes of manufacture, forms the basis for the variation in the performance of the materials in service. The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was one of the first to enter this field when eight or ten years ago it placed a nonmetallic gear material on the market.

In the manufacture of this product, specially woven duck first is impregnated thoroughly by passing the fabric through a tank of bonding solution at a definite pre-established speed. The material is impregnated to a degree depending upon the proposed ultimate use of the material, and then is dried systematically by passing through drying ovens maintained at the proper and uniform temperature.

The fabric then is cut into square sheets. A number of these sheets, in a sufficient quantity to give the desired thickness of the plate after the final operation is performed, are placed one upon another. The final operation consists of placing these assembled sheets in a hydraulic press where heat, at a uniform temperature, and a great pressure are applied simultaneously for the proper length of time. The heat, pressure and time are correlated and produce a finished product possessing the desired qualities.

In general these processes are followed by manufacturers of similar products. Some manufacturers have minor operations peculiar to their own processes and others vary the sequence of the difficult operations. The machining methods adopted generally are similar to



LEFT—FABRIC GEAR APPLIED TO A MIXING TANK—RIGHT—A WOOD PLANER USED IN THE PATTERN SHOP EQUIPPED WITH THE FABRIC GEAR

those used on soft metals. However, the speeds and feeds of the gear cutting machines may be increased somewhat. It is claimed that the wearing qualities of the fabric material when used as pinions and gears are satisfactory.

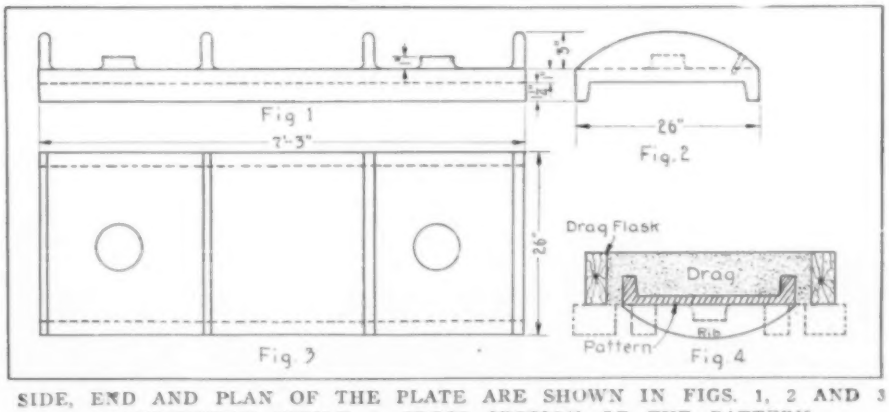
The uses for the fabric material in the various departments of a foundry are found to be wide and various. Gears of this type are used for the motor pinion of the pumps, for the power drive for cranes, conveyors and elevators, tumbling barrels and cinder mills. In the two latter instances, the special gear is used as a pinion on the motor and as a bevel gear to carry the power across the tumbling barrel shaft. A gear of this type also is used as a pinion on a motor driven sand mixer. The pattern department also offers several opportunities for the use of noise reducing pinions and gears on their various machines.

Pattern Also Serves As Rollover Board

FREQUENTLY the patternmaker is called upon to make a pattern for a ribbed plate similar to or closely resembling the plate shown in the accompanying illustration. Usually the pattern is drafted to mold with the deep ribs in the drag, but where, as in this instance, the casting is to present a clean, smooth, machine finished face on the side containing the two shallow, longitudinal ribs, the molder reverses the usual position of the pattern in the flask.

Recently I finished the pattern shown, to mold in the usual manner, and then was told that it would have to be molded the other way. The longitudinal strips were doweled in place, but the four ribs and two bosses on the other side were glued and screwed in place permanently. I was undecided at first whether to knock the ribs loose and locate them with pins, or let them stand and pass the buck to the molder. Finally I compromised by knocking them loose and then attaching them again by screws as shown at right, Fig. 2. In this way I assumed that the molder would remove the ribs before he placed the pattern on the rollover board and then screw them in place again after the drag was rolled over. If I had consulted the molder I might have saved time and trouble.

He did not use a rollover board. He blocked the pattern up on the floor in a manner to clear the ribs as shown in Fig. 4 and then placed additional blocking along each side and end to support the edge of the drag at the same height as the pattern plate. The drag then was rammed full of sand and rolled over. Three wood strips under the pattern and held in place by the bottom board clamps, served to hold the pattern in place while the drag was rolled over. As an alternative method I learned that the molder might have leveled a place on the floor, scraped away suitable depressions for the ribs and then rammed the drag in the usual manner.



SIDE, END AND PLAN OF THE PLATE ARE SHOWN IN FIGS. 1, 2 AND 3 RESPECTIVELY WHILE A CROSS SECTION OF THE PATTERN IN THE DRAG IS SHOWN IN FIG. 4

Special Mixture Lowers Iron Temperature

Question: Under ordinary circumstances we experience no trouble in securing hot, fluid iron from our cupola, but when we attempt to make a special mixture the iron is too dull to pour our work. We shall appreciate your advice on whether this is a common source of trouble or if possibly it may be due to some obscure cause.

Answer: Without more complete and definite data we should hesitate to offer an opinion. So many factors may be responsible for cold iron that any opinion offered will be largely a matter of guessing. The fact that under ordinary circumstances you secure hot iron would seem to indicate that you are operating your cupola in a competent manner and therefore presumably you are familiar with all the factors involved. You do not state what kind of material you use in the special charge, but it is quite possible that your trouble may be traced to that source. Fluidity of iron is due either to high temperature or to the chemical composition or to a combination of both. The addition of steel raises the melting point and the addition of low silicon, low phosphorus iron makes sluggish metal. In either event the resulting metal will not run as freely as gray iron melted under ordinary conditions. If the foregoing applies to your case the remedy naturally is to change the relative amount of coke and iron in the charge. If necessary change it several times until the resulting iron shows the desired temperature. Usually all that is required is to reduce the weight of the iron charge and leave the coke as it is. This solution is so obvious that we should hesitate to submit it were it not for the fact that we have found it to be true in many instances.

Move Main Office

The offices of the Sterling Grinding Wheel Co. have been removed from Tiffin, O. to Cleveland. This company was acquired by the Cleveland Stone Co., Cleveland, about two years ago. The plant of the Sterling company will remain at Tiffin. H. W. Caldwell, vice president of the Cleveland Stone Co., and for 20 years in charge of its grinding departments, is president of the Sterling Grinding Wheel Co.

Add To Capacity

The Great Western Smelting & Refining Co. has completed a new smelting plant at Detroit, the first unit having a capacity of 400 tons of metal daily. Practically every type of nonferrous metal is available to the various industries through this plant. J. B. Neiman is Detroit manager of this company.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

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SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada .....$4 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association
Entered at the Post Office at Cleveland as Second Class Matter

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Improving Foundry Conditions

DURING the past few years numerous improvements have been made in the foundry industry. These have been brought about by the desire of foundrymen to keep pace with other industries in their rapid progress, typical of the age. To this end suitable buildings have been planned and erected by engineers who have specialized along these particular lines. Further, modern and efficient molding machines, and other foundry equipment have served to increase production and lower costs. Applied chemistry, physics and metallurgy in a great measure have improved the quality of the product and have tended to eliminate waste. Although large expenditures have been made in bringing about these improvements, the good results obtained have more than compensated for such outlays. The employes also have benefited greatly by improvements in shop sanitation and comfort. Labor saving devices have made possible shorter hours with larger output and correspondingly increased remuneration.

A number of these improvements have been brought about by actual necessity under pressure of competition, but in many instances employers have been actuated by personal and humane motives. Such motives when they become prevalent will greatly strengthen employer and employe co-operation so essential to the growth and progress of any industry. These improved working conditions in time will have a tendency to overcome the apparent shortage of desirable men in this particular field of endeavor.

Finding Actual Production Costs

WHEN foundry business is below normal due to the restricted manufacturing activities or to cautious buying, prices covering jobbing work are close and competition is keen. At such times it is essential that foundrymen know their actual cost of production before it is safe to bid on work. Unreliable cost data often lead to serious financial losses. Foundrymen always should ascertain accurately their actual cost of production based on cost of raw materials, labor and overhead. Cost of raw materials and labor fluctuate from time to time. Overhead is more nearly uniform or fixed. This item is the most difficult to estimate owing to the complicated figures involved in its determination and this is the one item that the average foundryman is unable to ascertain correctly. Other important elements that enter into these calculations are the size of castings, quantities required, and amount of core work.

Ability to handle certain work on a definite time allowance may secure contracts and the time required to handle a job may determine the difference between profit and loss. When a shop lacks time and labor saving equipment their ability to make castings on a competitive price is limited. Forcing production with inadequate equipment always is wasteful. It requires overtime or speed-up, intensified effort which carries the hazard of loss through spoiled work.

Co-ordinating all the important items in cost determination will enable foundrymen to figure in an intelligent manner on miscellaneous castings and to discriminate on different classes of work. It will enable him to bid with confidence on contract work and if necessary to get the business by figuring closely to his margin of profit.

Trade Outlook in the Foundry Industry

IF AN observer were to test the condition of the foundry industry at the present time by interviewing a number of representatives of any single line of activity, a warped opinion would result. Consider the automotive cylinder shops. Practically all of the jobbing foundries making this class of castings are operating on curtailed schedule. In the same manner, if only sanitary ware foundries were studied an opposite opinion as to the state of business would be advanced. Sanitary shops are busy to capacity, are booking orders steadily and are buying iron and other commodities in advance. A cross section of the entire foundry field leads to an opinion that business is fair.

Automotives Puzzle

The automobile industry manages to confound all prophets with every turn of the business cycle. March was expected to register a heavy loss in production, according to advanced reports, and even the most hopeful among the friends of the industry thought some reversal would be encountered. Instead, revised figures show that a total of over 382,000 cars were produced in March. This is over 25,000 in excess of the first estimates and puts the monthly total within 3 per cent of the record month of all time, May, 1923. Further, a gain of 14,990 cars is shown in comparing the February total of 367,469 with the revised figures for March. However, April has witnessed a slackening in many plants and it is expected that the April totals will register a drop of about 15 per cent, when compared with March. Further, an increase in dealers stocks is noted, and deliveries can be obtained on short notice in practically any class of passenger automobile. Buying is not so active as it was in 1923, and sales resistance is more pronounced.

Prices for Raw Material for Foundry Use

CORRECTED TO MAY 7

Iron		Scrap	
No. 2 Foundry, Valley	$25.00	Heavy melting steel, Valley	$15.00 to 15.50
No. 2 Southern, Birmingham	22.00 to 23.00	Heavy melting steel, Pitts.	15.00 to 15.50
No. 2 Foundry, Chicago	23.00 to 23.50	Heavy melting steel, Chicago	13.50 to 14.00
No. 2 Foundry, Philadelphia	22.63 to 22.76	Stove plate, Chicago	17.00 to 17.50
No. 2 Foundry, Buffalo	20.00 to 21.00	No. 1 cast, Chicago	19.75 to 21.25
Basic, Valley	21.00 to 21.50	No. 1 cast, Philadelphia	17.00 to 18.00
Basic, Buffalo	21.00 to 22.00	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	23.00 to 23.50	No. 1 cast, Buffalo	18.25 to 19.00
Malleable, Buffalo	21.50	Car wheels, iron, Pittsburgh	16.00 to 16.50
Coke		Car wheels, iron, Chicago	16.50 to 17.00
Connellsville foundry, coke	$4.30 to 5.25	Railroad malleable, Chicago	18.50 to 19.00
Wise county foundry, coke	5.00 to 5.50	Agricultural mal., Chicago	17.00 to 18.00
		Malleable, Buffalo	19.00 to 19.50

Residences Increase

Building construction as reflected by the permits issued by many of the larger cities is characterized by an increase in the number of structures but a decrease in the total value. This indicates a predominance of residences and smaller commercial structures and is reflected by the continued strong demand for plumbing goods, sanitary ware, radiators and heating sundries. The orders for bath tubs, sinks, lavatories and miscellaneous sanitary ware has run consistently ahead of the shipments for the past several months. In March, for example, orders received for bath tubs, according to the department of commerce, totaled 117,911, while shipments were 104,842. Incidentally, the orders for February were 137,246, but in March of the preceding year they were only 116,514. Orders for lavatories totaled 129,119 compared with 148,414 for February and 148,121 for March, 1923. Similarly the demand for sinks and miscellaneous enamel products in March dropped slightly below the preceding month. Cast iron pipe shops continue capacity operations.

Iron Output Drops

Although the average foundry melt is probably between 60 and 75 per cent of capacity, forward buying of iron is rare. In many cases foundrymen are ordering small tonnages for immediate shipment and buying at a rate lower than their present melt. Instances are noted where small lots are placed with those furnaces which can make the earliest delivery, as orders are delayed until the need for iron is imperative. April registered a sharp decline in pig iron production according to statistics compiled by the *Iron Trade Review*. The total of iron produced during the past month was 3,226,401 tons, which when compared with the March output of 3,465,389 tons shows a loss in production of 238,988 tons. A total of 35 furnaces were blown out or banked during April. The loss in production on a daily basis shows 4241 tons or 3.8 per cent less iron produced in April than in March. The total of merchant iron made in April was 709,488 tons which when compared with the March production of 712,321 tons gives a drop of 2833 tons. On a daily average basis, April show a rate of 23,649 tons compared with a 22,978 ton daily output for March, giving a daily gain of 671 tons. Stove foundries have encountered a lull but still maintain a fair average rate of production. Malleable foundries reflect the general industrial situation. Those catering to automotive lines are slowing down, but railway electric and miscellaneous jobbing malleable foundries are active. According to the department of commerce, the total of orders booked in March reached 66.6 per cent of capacity. A comparison of 107 identical plants show orders for March at 66.2 per cent of capacity. Railway steel castings shops are active. The American Steel Foundries, according to a report of President Lamont, have orders on hand to insure operation at from 75 to 80 per cent of capacity for the next four months. Roll foundries continue to operate at about 75 per cent of capacity, though orders on hand represent only a few weeks operation at the present production rare. However, this condition has obtained for several months.

Nonferrous Prices

New York prices on nonferrous metals according to quotations in the *Daily Metal Trade* of May 7 follow: Casting copper, 13.00c; electrolytic copper, 13.25c; Straits tin, 47.50c; lead, 7.75c; antimony, 8.25c to 8.50c; nickel, 30.00c; aluminum, No. 12 alloy, open market, 22.50c to 23.00c. Zinc is 5.82½c to 5.85c, E. St. Louis, Ill. Average monthly prices for April follow:

New York Quotations

Casting Copper	Electro Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13,191	13.508	8.167	49,952	9.70	27.00	6.177

Personal

Elmer A. Gullberg, superintendent of the Union Malleable Iron Co., East Moline, Ill., and for 17 years in the employ of John Deere & Co., has resigned from his present connections as of May 31, to become assistant manager of the Columbus Malleable Iron Co., Columbus, O. Mr. Gullberg's successor has not been announced.

George Pohl has retired as manager of the Keystone Foundry, Plymouth, Ind., and J. H. Miller, who has been associated with Mr. Pohl, now is in charge of the concern.

Mackenzie MacIntyre, formerly connected with the Gifford-Wood Co., Bosson, N. Y., now is doing electrical testing work for the Victor Talking Machine Co., Camden, N. J.

Irving A. Pfeil of the Chicago office of the Blaw-Knox Co., Pittsburgh, has been appointed manager of the Detroit branch of this company succeeding the late Herbert J. Desson.

F. F. Elliott, formerly foundry superintendent of the Westinghouse Electric & Mfg. Co. at Springfield, Mass. has been made works manager of the foundry at the Cleveland plant.

P. J. Fasullo, recently connected with the Best Steel Casting Co., Oakland, Cal., as foundry foreman, has purchased the Hanford Foundry, Hanford, Cal., which operates gray iron, brass and aluminum departments.

Harry B. Klar is designing furnaces for the Hess-Shyder Co., Massillon, O. and equipping the shop for machine production of castings. Mr. Klar formerly was connected with the Hart Mfg. Co., Louisville, Ky., and previous to that time was with the Monitor Stove Co., Cincinnati, designing patterns and equipment and installing machinery. He also was with the 20th Century H & V Co., Akron, O., for four and a half years.

R. R. Fauntleroy, president of the Moline Malleable Iron Co., St. Charles, Ill., talked before the Quad City Foundrymen's association at a recent meeting in Moline, Ill. Mr. Fauntleroy brought out the good results that have been obtained by the co-operative efforts of some of the leading malleable foundries in the matter of chemical research and shop practice analysis. He stated that as a result of this effort the iron made in this country is superior to that made in other countries, and that European malleable interests are developing a similar program.

George S. Githins has been appointed district representative for New England by the Pennsylvania Pump & Compressor Co., Easton, Pa. Mr. Githins will have offices at 110 High street, Boston.

Charles F. Knowlton Dies At Cleveland

Charles F. Knowlton, works manager of the Westinghouse Electric & Mfg. Co., plant in Cleveland, died at his home in that city April 25. Mr. Knowlton was born in Woburn, Mass., Feb. 17, 1865. He was educated in the public schools, graduating from the high school at Northampton, Mass. He learned the patternmakers trade at Northampton and then went to Springfield, Mass., where he worked for approximately five years.

CHARLES F. KNOWLTON

After leaving Springfield he went to New Haven where he entered business for himself. He remained in New Haven for 8 years and then went to Port Chester, N. Y., where he worked in a stove plate plant. In 1889 he removed to Pittsburgh and became connected with the Union Switch & Signal Co., remaining there until 1893 when he entered the employ of the Westinghouse Electric & Mfg. Co. at East Pittsburgh as foreman of the pattern shop. He advanced from this position to general foreman and later to assistant superintendent of the foundry. In 1915 he was transferred to Cleveland as assistant superintendent of the Cleveland foundry. In 1918 on the resignation of Benjamin D. Fuller he was made works manager.

The Detroit testing laboratory recently moved into its new building at 554 Bagley avenue, Detroit.

Obituary

Herbert J. Desson, manager of the Detroit office of the Blaw-Knox Co., Pittsburgh, died, after a brief illness, on Wednesday morning April 16 at the age of 44 years. Mr. Desson was born in Cleveland and received his general education in the public schools of that city. He came with the Blaw-Knox Co. in 1916 and three years later was placed in charge of the company's Detroit branch.

A. F. Thomas, sales manager and advertising director of the Mathews Gravity Carrier Co., Ellwood City, Pa., died suddenly April 27. Mr. Thomas became associated with that company Jan. 1, 1912 in the capacity of advertising manager and in 1916 he assumed the added responsibility of manager of sales.

Discussion of Electric Refractories

Refractory linings for electric furnaces were discussed at a round table luncheon at the annual convention of the American Electrochemical society in Philadelphia, April 24. This session afforded opportunity to continue the discussion started at the Dayton meeting and noted in THE FOUNDRY Oct. 15, 1923. Dr. M. L. Hartman, director of the research laboratory of the Carborundum Co., Niagara Falls, N. Y., presided and the session was opened by Dr. Albert Stansfield, professor of metallurgy, McGill university, Montreal, Can. Among those present was Otto Frick of Sweden, inventor of the Frick electric induction furnace, who spoke. One point discussed was the extent to which lining troubles are due to unsatisfactory refractories or to the poor use of the refractory. It was the consensus of opinion that more trouble is due to poor use than to poor quality.

Considerable discussion centered upon the question as to whether fused magnesia is preferable to burned magnesia and it was pointed out that fused magnesia has less contraction but a higher cost. Dolomite has been used successfully in electric furnace bottoms in place of magnesite it was said. One speaker told of melting 13,000 tons on a dolomite bottom in a basic electric furnace. However, it was stated, that dolomite should not be ordered too far ahead of its use, since it deteriorates with age.

The roof problem was discussed. It was thought that roofs of magnesite or some other substitute will be developed in the future but that the

most useful material at present continues to be silica.

Attendance at the round table session was much larger than expected, about 140 participating. The character of the discussion reflected widespread interest in electric furnace refractories.

Presents Research Plan to Engineers

"Reduction of Costs through Co-operative Research Work," was the title of a paper presented by William J. Corbett, industrial engineer, Electric Steel Founders' Research group, Chicago, before the national convention of the Society of Industrial Engineers held at the Hotel Statler, Buffalo, April 30, May 1 and 2. Mr. Corbett reviewed the history of the research group and traced its growth and activity. In addition to studying problems related to foundry practice and production the organization concerns itself with problems of cost accounting, plant operation, industrial relations and similar related problems. The speaker stated he felt that other industries would find it of advantage to conduct similar co-operative programs.

Throughout the convention the main theme of discussion was "Reducing the Cost of Business." Three main phases of the subject were discussed, namely, reducing the cost of manufacture, reducing the cost of selling, and reducing the cost of personnel. The latter, while somewhat new, now seems to be of extreme importance.

Among the important papers presented were the following: "What Is Needed from the Management Point of View," by Benjamin A. Franklin, vice president, Strathmore Paper Co., Mittineague, Mass.; "Illumination—A Fatigue Factor" by Ward Harrison, National Lamp Works, Cleveland; "Reducing the Cost of Selling" by Ralph Barstow, secretary, Marquis Regan, Inc., New York, Reduction of Costs through Industrial Engineering" by Carle M. Bigelow, Bigelow, Kent, Willard & Co., Boston, "Classification of Work" by Frank B. Gilbreth, consulting engineer, Montclair, N. J.; "Reducing the Cost of Manufacture" by Keppele Hall, Joseph & Feiss Co., Cleveland; and "The Part of the Personnel Manager in Cost Reduction" by F. W. Pierce, personnel manager, Goodyear Tire & Rubber Co., Akron, O. At the banquet held on Friday night L. W. Wallace, executive secretary of the American Engineering Council, Washington, made an address, "Education-Civilization-Peace."

Cupola Charger Handles Heavy Loads

The P. H. & F. M. Roots Co., Connersville, Ind., recently has made a number of changes in the design of its cupola charging hoist. The changes were made to develop a heavier machine that would function under the severe charging conditions found in the larger foundries.

The frame of the charger consists of two structural steel channels bent as shown in the accompanying illustration. The frame carries the hoisting and traveling mechanism in a compact unit. The traveling mechanism operates on the lower flange of a standard I-beam. Standard crane motors of either alternating or direct current are used. The motors have a maximum lifting capacity of 4 tons, a hoisting or rope speed of 50 feet per minute and a traveling speed of 200 feet per minute on the monorail.

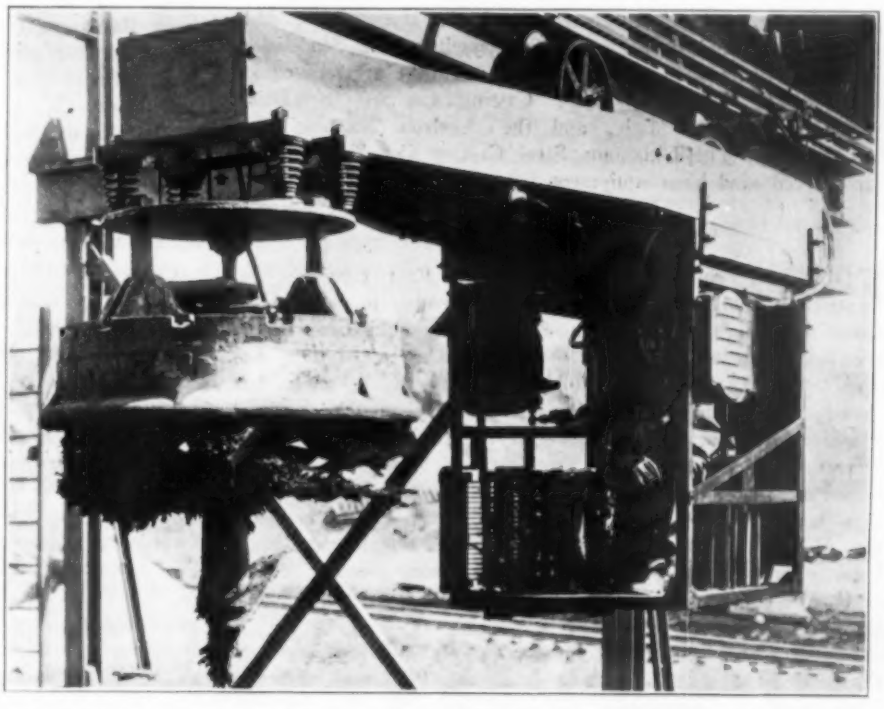
The machine is equipped with steel gears and pinions, roller bearings having the inner race pressed on the high carbon steel shafting, and forced lubrication. A circular steel plate, which suspends the magnet, protects the magnet and hoisting cables from the cupola flames and also trips the limit switch in hoisting. The four absorber springs serve as extra protection against the overwinding of the cables.

The hoist may be equipped with either magnet or charging bucket. The hoist takes the charge of pig iron, scrap, coke and limestone into the cupola, and is designed to lower the material to the bed without disturbing or pulverizing the coke or injuring the furnace lining. A view of the charger with an electric magnet attached is shown in the accompanying illustration.

Centrifugal Castings

The centrifugal castings business of Stokes Castings, Ltd., Union Foundry, Mansfield, Eng., has been transferred to the Sheepbridge Stokes Centrifugal Castings Co., Ltd., Chesterfield, associated with the Sheepbridge Coal & Iron Co. A new plant, exclusively for the manufacture of centrifugal castings, has been built at Chesterfield. Equipment has been provided for making much larger castings than heretofore, including steel tires, small flywheels, etc., as well as piston drums, cylinder liners, and other smaller castings. F. W. Stokes, managing director of Stokes Castings, Ltd., has been appointed managing director of the new company. Details of the Stokes process of making centrifugal castings were published in the March 15, 1922, issue of THE FOUNDRY.

The Mahr Mfg. Co., Minneapolis, has issued a folder entitled "Co-operation Between Buyer and Seller," which was written by W. H. Horner, president of the company. The principles and practices followed by the company and its representatives in presenting products to the prospective buyer are outlined carefully, together with the fundamentals to be followed by the buyer in purchasing materials.



CHARGER CAN BE EQUIPPED WITH MAGNET OR CHARGING BUCKET FOR HANDLING MATERIAL FOR THE CUPOLA

Equipment Inquiries Heavier

Manufacturers See Brighter Outlook In Increased Activity Among Prospective Buyers—Sizeable Sales of Foundry Machines Continue Scarce—Orders for Cranes Are Fairly Heavy

WHILE buyers of foundry equipment continue to delay closing on sizeable orders, a substantial increase in the number of inquiries for various lines of equipment has been noted during the past week in several distributing centers. Manufacturers feel that the increased activity indicates that a better volume of business will be realized in the near future. The W. W. Sly Mfg. Co., Cleveland, has sold tumbling barrel equipment to the Vesta Gas Range Co., Chattanooga, Tenn., the McKinnon Industries, St. Catharines, Ont., and James B. Clow & Sons, Coshocton, O. The W. W. Sly company also sold dust arrester equipment to the Dayton Malleable Iron Co., Irontown, O., and the Ford Motor Co. of Canada, Walkerville, Ont. The Great Western Mfg. Co. Leavenworth, Kan., is in the market for electric hoists and machine tools.

Better Tone Noted In West

THE pessimism that has gripped the foundry industry in the Chicago district seems to have disappeared somewhat in the past few days. It is understood that some of the automobile contracts that have been held up are about to be released. This improvement is expected to hearten the makers of foundry equipment. The National Engineering Co., Chicago, has placed its sand mixers in the foundries of the Consolidated Iron & Steel Mfg. Co., Cleveland; O. S. Kelly Co., Springfield, O.; Wagner Malleable Iron Co., Decatur, Ill., and the Western Electric Co., Chicago. The W. W. Sly Mfg. Co., Cleveland, has sold tumbling barrel equipment to the Link-Belt Co., Chicago, and the Jewell Steel & Malleable Co., San Francisco. The same company has sold dust arrester equipment the Muncie Malleable Foundry Co., Muncie, Ind. The Pangborn Corp., Hagerstown, Md., has sold sand and dust arrester equipment to the Studebaker Corp., of America, South Bend, Ind., and dust arrester equipment to the Michigan Motor Casting Co. of the Buick Motor Co., Flint, Mich., and the Axelson Machine Co., Los Angeles. The Oklahoma Steel Casting Co., Tulsa, Okla., has ordered sand blast equipment from the Pangborn Corp.

Eastern Buying Is Restricted

FOUNDRY equipment buying in the East continues restricted. Sellers are finding an improvement in demand for flasks and other supplies, but few sizeable equipment orders are being placed. Possibly the largest buyer of late has been the Boynton Furnace Co., Jersey City, N. J., which has closed through the Austin Co., Philadelphia, on 11 overhead cranes and other equipment for its new stove foundry. However, there are molding machines and a number of other items still to be purchased. The cranes are understood to have been placed with the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., and include 10 3-ton, single I-beam 1-motor cranes, 28-foot span, and one 5-ton, 3-motor crane, 67-foot, 6-inch span, equipped with 55-inch magnet, for yard service.

The Nevada Consolidated Copper Co., New York, has purchased 1½-ton electric furnace from the Pittsburgh Electric Furnace Corp., Pittsburgh, for installation at its plant at McGill, Nev. The Driver-Harris Co., Harrison, N. J., is expected to close shortly on an electric furnace. The Farrell Foundry & Machine Co., Ansonia, Conn., has been a further purchaser of some miscellaneous equipment recently. Sand blast equipment has been sold to the Connecticut Foundry Co., Rock Hill, Conn. The Crane Co., Bridgeport, Conn., bought tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland

Inquiries Good in Pittsburgh Territory

ALTHOUGH curtailment and retrenchment policies have been adopted to a certain extent among foundries in the Pittsburgh district, occasionally a foundry equipment sale is noted. The inquiry rate still is fairly high and numerous sales of molding machines are expected before the month is out. The American Brake Shoe & Foundry Co., Buffalo and one or two others have purchased molding machines. Others are deferring action. The Standard Sanitary Mfg. Co., Pittsburgh, is investigating molding machines both for Baltimore, Md., its large addition at Louisville, Ky., as well as other plants. The J. S. McCormick Co., Pittsburgh, has received numerous orders for a cupola charging can which it markets. Small foundries are ordering 150 or 200 at a time while the larger foundries take 1000 or more at a time. This device is designed to melt borings and turnings in the cupola. The McCormick company recently has sold a core oven to the Allegheny Steel Co., Brackenridge, Pa., a portable core oven to the Union Steel Casting Co., Pittsburgh, and a crane ladle to the Pittsburgh Plate Glass Co., Creighton, Pa. It now is at work on a sand blast inquiry from a Michigan foundry as well as several other propositions near by. A sand blast mill and pressure tank has been sold to the Westinghouse Air Brake Co., Wilmerding, Pa., by the W. W. Sly Mfg. Co., Cleveland. The Fowler & Wolfe Mfg. Co., Norristown, Pa., bought tumbling mill equipment from the same company. The Pangborn Corp. Hagerstown, Md., has sold sand blast and dust arrester equipment to the Westinghouse Air Brake Co., sand blast equipment to the Erie Forge Co., Erie, Pa., and dust arrester equipment to the T. B. Woods Sons Co., Chambersburg, Pa. Numerous steel flasks were bought by the Grove City Brass & Bronze Co., Grove City, Pa. The movement of miscellaneous small equipment such as flasks, riddles, etc., is reported to be fairly good among various sellers.

Cranes, hoists and heavy equipment of that nature find a fairly ready sale among foundries. The H. K. Porter Co., Pittsburgh, bought one each 5-ton and 3-ton overhead traveling cranes from the Northern Engineering Works, Detroit. The Standard Sanitary Mfg. Co., Pittsburgh bought a 50-ton locomotive crane for its Baltimore, Md., plant through Ridenour, Seaver & Kendig, Pittsburgh. The Mansfield Foundry Co., Mansfield, Mass., purchased a 10-ton crane with 67-foot 6-inch span from the Pawling & Harnischfeger Co., Milwaukee, while the American Laundry Machinery Co., Rochester, N. Y., awarded a 3-ton single I-beam crane with 21-foot span to the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The Canadian Westinghouse Co., Ltd., Hamilton, Ont., purchased a 5-ton 4-motor traveling wall crane with a 25-foot reach and a 1-ton 4-motor traveling wall crane with a 20-foot reach from the Milwaukee Electric Crane & Mfg. Co., Milwaukee. The Lorain Steel Co., Johnstown, Pa., is about to close on a 20-ton crane with 5-ton auxiliary. The Lunkenheimer Co., Cincinnati, operating a valve foundry,

will possibly be in the market for some equipment for a new addition at Carthage, O., while the Jacobs Stove Co., Bridgeport, Ala., will enlarge and equip a plant at Avondale, Ala., purchased from the Avondale Stove & Foundry Co.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Dixie Foundry Co., Cleveland, has surrendered its charter.

The Columbia Malleable Castings Co., Portland, Me., has been organized.

The Bell Furnace & Mfg. Co. is the new name of the properties recently sold to Parker & Gerkin, Howell, Mich. *Noted April* 15.

The Mechanics Iron Works, 901 South Ewing avenue, St. Louis, is constructing 1 and 2-story, 98 x 108-foot foundry on Edmund street.

Germer Stove Co., 1602 Parade street, Erie, Pa., was damaged by fire recently. The company operates gray iron and aluminum foundries.

Western Foundry & Furnace Co., 3002 South Chandler street, Tacoma, Wash., operator of a gray iron foundry, recently increased its capital stock from $50,000 to $99,000.

Smith Bros. Foundry, Beaverton, Ont., is reported as being in the market for foundry and machine shop equipment. The company operates a gray iron foundry.

The Globe Furniture Co., Waterloo, Ont., plans a foundry and machine shop, and is interested in the purchase of machinery and tools. John Bahnsen is manager.

The C. & G. Foundry, Indianapolis, Ind., is preparing plans for enlarging its plant at 1026 Kentucky avenue. The company recently was incorporated.

The Tanite Co., Stroudsburg, Pa., manufacturer of emery products for abrasive purposes, plans reconstructing plant unit damaged by fire March 16.

The Laetz Foundry, Bay City, Mich., has been incorporated to manufacture gray iron, brass and aluminum castings, with W. S. Cooley as manager and Chris Laetz.

Lockwood Mfg. Co., Day and Raymond streets, Norwalk, Conn., plans 3-story 55 x 70-foot plant addition of reinforced concrete. The Lockwood company does machinery and foundry business.

Werner G. Smith Co. will establish a plant at Hamilton, Ont., for the manufacture of core oil and foundry supplies, according to C. W. Kirkpatrick, industrial commissioner of that city.

The Oxford Foundry & Machine Co., Oxford, N. S., rebuilding its machine shop recently damaged by fire, is in the market for tools and equipment including tilting table; hand crane, etc. H. W. Wood is a director. *Noted May* 1.

East St. Louis Castings Co., East St. Louis, Ill., operator of a gray iron foundry has let contracts to Kekley Bros. Construction Co., Belt and State streets, for a 1-story brick and steel plant.

Charles T. Rieder, Petoskey, Mich., plans constructing foundry building on Buckley avenue, that city. A 30 x 48-foot plant will be the first unit. Brass castings will be produced.

The Rhode Island Malleable Iron Works, Hillsgrove, R. I., is planning to construct a new foundry building with additions to its power plant, etc. Frank D. Chase, Inc., 720 North Michigan avenue, Chicago, is engineer.

The Jacobs Stove Co., Bridgeport, Ala., has purchased the plant at Avondale, Ala., of the Avondale Stove & Foundry Co. and plans enlarging the recently acquired buildings. O. L. Dortch is president of the Jacobs company, G. O. Staley, vice president; T. A. Stanley, secretary and M. I. Moody, treasurer. Patterns and equipment will be transferred to the Avondale plant from the one at Bridgeport.

Hoy & Co., Albany, N. Y., has been incorporated for $200,000 to manufacture plumbing supplies and materials, by F. S. Gaylord, J. Eberle and W. L. Mayer. G. J. Hatt, II, Albany, is attorney.

Forged Metal Corp., New York, has been incorporated for $20,000 to make metal castings, by L. G. Fritz, T. P. Mackey and J. M. McNamara. J. A. McNamara, 165 Broadway, New York, is attorney.

James A. Reese, Memphis, Tenn., has purchased a 6-acre site for constructing a gray iron foundry. The site purchased is along the Illinois Central Belt line and Hernando road.

Pacific Foundry Co., 1113 St. Paul avenue, Tacoma, Wash., was damaged by fire April 3, and operations were stopped. Immediate reconstruction is planned. Most of the equipment was damaged.

Kohler Co., Kohler Wis., operator of a gray iron foundry and manufacturer of bath tubs, soon will start constructing 4-story, 65 x 210-foot plant to contain laboratories and experimental shops. Brust & Philipp, Broadway building, Milwaukee, are architects.

Becker Mfg. Co., Two Rivers, Wis., manufacturer of castings and machined parts, and operator of a gray iron foundry, plans an addition to its foundry. Frank Becker is president and Michael Becker secretary and treasurer.

Quality Aluminum Castings Co., Waukesha, Wis., soon will award contracts for constructing 1-story brick and steel addition, 42 x 100 feet, to house a core room and casting shop. Another furnace probably will be installed. A. C. Pankratz, formerly vice president of the Werra Aluminum Foundry Co., is president and general manager of the new company.

Warner Brass Works, 1801 North Fairfield avenue, has been incorporated for $30,000 to conduct a brass and iron foundry. John E. Vannatta, Richard Haldowang and Joseph McDermott were among the incorporators.

Advance Stove Works, Reed and Indiana streets, Evansville, Ind., has retained Alfred E. Neucks to prepare plans for 2-story, brick constructed plant. The Advance company operates gray iron and aluminum foundries.

National Steel Products, Ltd., Toronto, Ont., has been incorporated for $100,000 to manufacture and deal in iron, steel, forgings, machinery, etc., by George P. Weatherhead, Malcolm S. Clark and Duncan D. McLeod.

Founders Sand & Supply Co., Detroit, has been incorporated with $50,000 capital by John O. Carritte, 112 Edison avenue, James T. Warner and Lee T. Mentz, to deal in foundry supplies and equipment.

The Worthington Pump & Machinery Corp., New York, has turned over its works at Cudahy, Wis., to the Allis-Chalmers Mfg. Co., Milwaukee. The Worthington corporation operated gray iron and malleable foundries at Cudahy and manufactured crushing, cement, mining and creosoting machinery. On May 1 the patterns, jigs, fixtures, etc. were turned over to the Allis-Chalmers company, at West Allis, Wis.

Acme Foundry & Machine Co., Coffeyville, Kans., recently was damaged by fire with most of loss being confined to the pattern room. The company operates gray iron, brass and aluminum foundries. E. L. Graham is general manager.

Rogers Foundry & Mfg. Co., Joplin, Mo., operator of a gray iron foundry, has acquired the plant of the Joplin Steel & Malleable Co. which it will enlarge. The Rogers company plans the purchase of additional equipment. John A. Rogers is president.

Enterprise Foundry Co., 1111 St. Paul avenue, Tacoma, Wash., operator of brass and aluminum foundries, was damaged by fire April 3. Operations were but temporarily delayed although considerable damage was done to equipment.

Standard Sanitary Mfg. Co., Pittsburgh, is planning another addition to its plant at Louisville, Ky. Building is to be 1-story, 140 x 180 feet. Joseph & Joseph, 800 Francis building, Louisville, Ky., are architects and engineers.

Worthington Pump & Machinery Corp., New York, sold its plant at Hazleton, Pa., recently to the Pennsylvania Power & Light Co. The Hazleton plant formerly was used as a munition plant. A gray iron foundry was operated there, but had been idle since June 1, 1922.

McKinnon Industries, Ontario street, St. Catharines, Ont., plans addition to its plant and has awarded construction contracts to Newton Bros. The McKinnon company manufactures automobile accessories, carriage hardware, etc., and operates steel, malleable, brass and aluminum foundries.

American Lawn Mower Co., Muncie, Ind., operator of a gray iron foundry, has plans for addition to plant, 50 x 10 feet, of steel and concrete construction. Machinery in the present plant will be moved to the new building and additional equipment purchased for the old quarters.

Hoover Suction Sweeper Co. of Canada, Ltd., Hamilton, Ont., has awarded construction contracts to W. H. Cooper, Clyde building, that city, for addition to plant at Gage avenue north. Architect is B. H. Prack, Landed Bank & Loan building. The Hoover company operates an aluminum foundry.

The P. H. MaGirl Foundry & Furnace Works, of Bloomington, Ill., operator of a gray iron foundry, is constructing 50 x 95-foot plant to increase capacity of furnace department. Additions to foundry also are being built. A mill for cleaning and polishing castings will be provided.

The William J. Collins Foundry Co., Milford, Mass., organized in October, 1923, by William J. Collins, has awarded construction contracts to Dillon Bros., for 1-story, 55 x 60-foot foundry with 15 x 30-foot extension to produce iron and other metallic castings. *Noted Nov.* 15, 1923.

Riverside Brass & Aluminum Foundry Co., Grand Rapids, Mich., has been incorporated for $15,000 to make brass, aluminum and

other metallic castings. George G. Cadey, Henry Buskers and Leonard De Vos, 15 Mt. Vernon street, N. W., were among the incorporators.

Prime Mfg. Co., 653 Clinton street, Milwaukee, operator of brass and aluminum foundries, has let construction contracts to Paul Riesen's Sons, 1418 Humboldt avenue, for 1, 2 and 3-story, 80 x 160-foot plant. Frank D. Chase, Inc., Chicago is engineer. *Noted Dec.* 15, 1923.

The E. J. Scudder Foundry & Machine Co., Canal and Pearl streets, Trenton, N. J., has been incorporated for $50,000 to build machinery, operate a gray iron foundry and do general machine shop work. E. J. Scudder, organizer, formerly was with Duncan MacKenzie's Sons Co., Trenton, N. J., machinists and foundry operators.

Athens Plow Co., Athens, Tenn., has awarded contracts for constructing new foundry unit to be completed before July 1. Seeger Machine Tool Co., Atlanta, Ga., will furnish the machinery for the machine shop. The daily output of the new foundry will be about four tons a day. J. G. Stephenson is head of the company. *Noted May* 1.

Great Western Mfg. Co., Second and Choctaw streets, Leavenworth, Kans., damaged by fire April 3, has plans ready for reconstructing damaged buildings. The machine shop suffered heaviest damage. The company is seeking approximately 40 machine tools to outfit its reconstructed plants. Electric hoists, etc., are to be bought. Samuel H. Wilson is president.

Superior Brass & Aluminum Casting Co., Lansing, Mich., recently acquired property at 811 Jerome street, where it plans production of nonferrous castings. C. H. Harb, head of the new Superior company, which recently was organized, was connected with the Michigan Brass & Iron Works. C. D. Coffman also is interested in the Superior company.

New Trade Publications

INDUCTION MOTORS — The Century Electric Co., St. Louis, has issued a leaflet describing its polyphase squirrel cage induction motors, giving specifications and details of construction.

SAND MACHINES—A bulletin issued by the Newaygo Engineering Co., Newaygo, Mich., describes and illustrates a machine for disintegrating and screening sand in one operation.

DUST COLLECTORS—The Dust Recovering & Conveying Co., Cleveland, has issued bulletin No. 11, illustrated by halftones and diagrams to indicate the value of dust collectors in filtering fine material from the air by a modern method.

CIRCUIT BREAKERS—Bulletin No. 530 of the Roller-Smith Co., New York, describes in detail the circuit breaker perfected and manufactured and presents much tabular matter relative to electric loads, both over and under, for various types of curent.

SCREENS—The Link-Belt Co., Philadelphia, has published a folder describing a vibrating screen designed for screening by-products, coke, gypsum, cement, fertilizers, coals, pigments, etc. The pamphlet is illustrated with views of the machine.

SAND MACHINES—The Royer Foundry & Machine Co. has issued a folder describing and illustrating several models of a sand separator and blender. Four views of this machine in actual operation in the foundry are shown and the dimensions of the various types are given.

ELECTRIC FURNACES—A booklet on brass melting recently has been issued by the Detroit Electric Furnace Co., Detroit. The various economies claimed for the electric furnace are listed and controlling analysis, color, texture and homogeneity are discussed.

CHAIN FURNACE SCREENS—Use of chain screens over furnace and oven doors to interrupt heat radiation and at the same time allow view of the interior, as well as to give ingress to the material to be heated with a minimum loss of heat, is explained in a brief catalog by the E. J. Codd Co., Baltimore.

STEAM FIXTURES—The Strong, Carlisle & Hammond Co., Cleveland, has issued a 40-page booklet describing many fixtures necessary in steam control and regulation, such as steam props, boiler feed regulator, separators, vacuum traps, reducing valves, governor and pressure regulator, check valves, and engine stops.

CASTINGS—John Harper & Co., Ltd., Willenhall, England, has issued a 24-page booklet describing castings in gray and malleable iron and semisteel. The various kinds of castings made by this company are listed and the physical properties of mixtures used are given. The booklet is well illustrated with reproductions of photographs of many of the types of castings made.

PIPE CUTTERS—Three new sizes of pipe cutters added to the line of the Borden Co., Warren, O., are described in a bulletin published by that company. The cutters operate on the same principle as other cutters made by this company, but the application is different, allowing large sizes to be cut by hand or by the application of power if desired.

ELECTRIC FURNACES—Electric furnaces for producing steel, alloy steel, malleable iron, tool steel, gray iron, steel for forgings, etc., are described and illustrated in a folder published by William Swindell & Brothers, Pittsburgh. Various improvements that lately have been made to this furnace are summarized.

PIPE THREADING MACHINE—A 32-page booklet and a 4-page folder describing and illustrating a portable power pipe machine has been issued by the Williams Tool Corp., Erie, Pa. This tool provides the plumbers and steamfitters with a speedy method of cutting threads on pipe. The booklet is well illustrated.

GRINDERS—Swinging frame grinding and polishing machines are described in a pamphlet published by the Excelsior Tool & Machine Co., East St. Louis, Ill. The device is entirely self contained, either belt or motor driven, and is adaptable to foundry operations.

CRANES—The various uses to which cranes and hoists are adaptable are illustrated in a folder recently issued by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The use of the combination of the crane and hoist in the foundry also is shown.

CONTROL INSTRUMENTS—The necessity of a means of temperature control when gas and oil is used as a fuel in industry is described in a pamphlet published by the F. J. Ryan & Co., Philadelphia. The apparatus manufactured by this company for application to this field also is described.

HEAT RESISTING CASTINGS—Castings designed to resist high temperatures in various industrial processes are described and illustrated in a 16-page catalog issued by the Ohio Steel Foundry Co., Springfield, O., as a bulletin. A series of alloys developed for strength and resistance to oxidation and corrosion at high temperatures, each for a special industrial requirement. Castings for various uses under high temperatures are illustrated and the general applications of the alloys are listed.

WIDE SERIES BEARINGS—The Rollway Bearing Co., Inc., Syracuse, N. Y., has issued a catalog illustrating bearings for industrial service. The wide series of bearings are supplementary to the precision bearings heretofore presented and are intended to be used under conditions where the former are not required. Tables describing various assemblies are included.

RECUPERATORS—The "Calco Handbook of Recuperation," issued by the Calorizing Co., Pittsburgh, starts with the reason and proceeds through the advantages of recuperation applied to types of heat salvage apparatus, the principles of combustion, improvement of combustion, reduction of oxidation, influence of recuperation on flame temperature, and the theory of recuperator design to the calorizing process. The book is filled with charts illustrating the various sections, and blueprints of various types of apparatus for recuperation.

CENTRIFUGAL BLOWERS AND COMPRESSORS—Blowers and compressors of the centrifugal type and their application in water gas, coke oven and general industrial plants are described in a catalog by the De Laval Steam Turbine Co., Trenton, N. J. The apparatus desribed includes single and multistage blowers and compressors up to 125 pounds per square inch. Illustrations show numerous installations in various sorts of plants. Blower and compressor characteristics and testing are discussed.

HEAT ENDURING CASTINGS—Castings exposed to temperatures as high as 2100 degrees Fahr. are described in a booklet by the Calorizing Co., Pittsburgh. Alloys suitable for the production of such castings are described and the entire subject gone into, including the work of the General Electric Research Laboratories and the engineers of the Calorizing Co. Chapter headings include heat endurance, higher quality at lower prices, temperature range, uses, and general data.

PLATING APPARATUS—A piece of plating apparatus having a moving cathode is described and illustrated in a folder recently published by the United States Galvanizing & Plating Equipment Corp., 32 Stockton street, Brooklyn, N. Y. The folder tells the simplicity of operation, amount of labor required, floor space necessary, mechanism controlling the speeds, methods of installation, etc. Views of various parts of the machine also are included.

MATERIAL HANDLING EQUIPMENT—In its catalog No. 21-M the Yale & Towne Mfg. Co., Stamford, Conn., presents a thoughtful and well illustrated discussion by Henry R. Towne of the comparative efficiencies of three types of chain blocks. This discussion gives a guide to the user in the choice of such equipment. The differential, the screw-geared and the spur-geared block, all of which are manufactured by this company, are rated as 31 per cent, 40 per cent and 80 per cent efficient. The illustrations graphically portray the work accomplished by each. The remainder of the catalog sets forth the various types of equipment and details of construction.

GEARS—A New handbook is being edited which will be combined with the regular catalog of the William Ganschow Co., Chicago. The purpose of the handbook is to afford the users of gears and speed transformers easy access to formulas and data regarding the design and use of gears. In addition this handbook will contain much information that is useful in the designing of machinery to which gears are applied. Tables also are included showing strength and weight of materials, trigonometric functions, geometric formulas, decimal equivalents, wire and sheet metal gages and standard screw threads together with other miscellaneous information.